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ILLUSTRATIONS OF FUNGI—XXX

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In the accompanying plate, an attempt has been made to illustrate a few of the larger polypores, which would require much more space for adequate representation. The species selected occur on living or dead trees in the vicinity of New York City, some of them in abundance.

Ganoderma Tsugae Murrill

HEMLOCK GANODERMA

Plate 6. Figure 1. × ½

Pileus corky to woody, fan-shaped, convex above, concave below, 4–20 × 5–25 × 1–4 cm.; surface glabrous, uneven, concentrically sulcate, laccate, lustrous, yellowish-red to mahogany-colored, at length black; margin light-yellow, acute, becoming concolorous, truncate, and marked with many shallow furrows, often undulate and at times more or less lobed; context soft-corky, radiate-fibrous, white or nearly so, 1–3 cm. thick; tubes annual, 0.5–0.75 cm. long, 4–6 to a mm., brown within, mouths circular or polygonal, white to light-cinnamon, edges obtuse, becoming acute; spores ovoid, obtuse at the base, attenuate and truncate at the apex, appearing verrucose, yellowish-brown, 9–11 × 6–8 μ; stipe lateral, ascending, frequently forked, cylindric, equal, 2–20 × 1–4 cm., resembling the pileus in color, surface and context.

Common on decaying trunks, stumps, and roots of hemlock throughout the range of this tree in America. The varnish begins to exude from the very young hymenophore, as shown in the figure, and soon spreads over the entire surface. The generic name refers to this character.

[MYCOLOGIA for March (11: 51–100) was issued March 17, 1919.]

Inonotus dryophilus (Berk.) Murrill

OAK-LOVING INONOTUS

Plate 6. Figure 2. × 1

Pileus thick, unequal, unguliform, subimbricate, rigid, 7–8 × 10–14 × 2–3 cm.; surface hoary-flavous to ferruginous-fulvous, becoming scabrous and bay with age; margin thick, usually obtuse, sterile, pallid, entire or undulate; context ferruginous to fulvous, zonate, shining, 3–10 mm. thick; tubes slender, concolorous with the context, about 1 cm. long, mouths regular, angular, 2–3 to a mm., glistening, whitish-isabelline to dark-fulvous, edges thin, entire to toothed; spores subglobose, deep-ferruginous, 6–7 μ; cystidia scanty and short; hyphae deep-ferruginous.

Occasional on living or dead oak trunks throughout the United states, causing serious decay. The specimen figured was taken from a living white oak in the New York Botanical Garden in September, 1912. See *Mycologia* **1**: 84 and **9**: 39.

Ganoderma sessile Murrill

SESSILE GANODERMA

Plate 6. Figure 3. × ½

Pileus corky to woody, dimidiate, sessile or stipitate, imbricate or connate at times, conchate to fan-shaped, thickest behind, thin at the margin, 5–15 × 7–25 × 1–3 cm.; surface glabrous, laccate, shining, radiate-rugose, concentrically sulcate, yellow to reddish-chestnut, at length opaque, dark-brown, usually marked near the margin with alternating bay and tawny zones; margin usually very thin and acute, often curved downward, often undulate, rarely becoming truncate, white, at length concolorous; context soft-corky or woody, radiate-fibrous, concentrically banded, ochraceous-fulvous; tubes 0.5–2 cm. long, 3–5 to a mm., brown within, mouths circular or angular, white or grayish-brown, edges thin, entire; spores ovoid, obtuse at the base, attenuate and truncate at the apex, appearing verrucose, yellowish-brown, 9–11 × 6–8 μ; stipe laterally attached, usually ascending, irregularly cylindric, 1–4 × 0.5–1.5 cm., resembling the pileus in color, surface and substance, often obsolete.

Frequent on diseased trunks and dead stumps from New England to Ohio, Missouri, and southward. Described in 1902 from sessile forms found on stumps of deciduous trees about New

York City. The specimen figured grew on a red maple stump. Stipitate forms also occur and may possibly connect it with *Ganoderma lucidum* of Europe.

Tyromyces Spraguei (Berk. & Curt.) Murrill

SPRAGUE'S TYROMYCES

Plate 6. Figure 4. × 1

Pileus subimbricate, dimidiate or flabelliform, broadly sessile or attenuate behind, convex, fleshy-tough and watery to rigid and fragile when dry, 4–7 × 5–10 × 1–2 cm.; surface at first milk-white, finely tomentose to glabrous, slightly tuberculose, azonate, sodden, containing depressions filled with exuded water, becoming discolored and roughened and often decaying, especially in damp weather, with a strong and disagreeable odor; margin undulate or slightly lobed, acute, usually discolored, sometimes smoky-black, inflexed when dry; context white, zonate, cheesy when fresh, rigid and somewhat fragile when dry; tubes small, white to yellowish within, 3–8 mm. long, mouths somewhat uneven, angular, 3–4 to a mm., edges white to yellowish, thin, entire; spores ellipsoid, smooth, hyaline, $6 \times 4\,\mu$.

Common in the eastern United States on decaying stumps and trunks of chestnut and oak. The specimen figured was taken from a white oak tree in the New York Botanical Garden.

NEW YORK BOTANICAL GARDEN.

THE CANADIAN TUCKAHOE

H. T. GÜSSOW

(WITH PLATES 7–9)

During some eight years past there have been received and examined, from the wooded regions (principally poplar woods) of the provinces of Manitoba and Saskatchewan, a number of large fungous sclerotia, such as one finds occasionally referred to in literature. Nearly all these references are sufficiently definite in showing that sclerotia similar to those under examination here have been frequently enough observed, but all records are as cautious as they are meager in supplying critical information relating to the classification of these sclerotia.

Of the twenty and more specimens seen from time to time, it may be said that they agree in character, appearance and composition, and no doubt are all identical.

They ranged from the size of a hen's egg to that of a cocoanut still within its fibrous covering. The largest specimen seen by us was an oval body and measured when fresh 22 inches by 33½ inches in circumference; its weight was 8 lbs. 4 ozs. After several years' drying, this sclerotium was reduced in size to 20 inches by 29 inches, and in weight to 6 lbs. 13 ozs.

On arrival and while still fresh, these masses bounce like a solid rubber ball, though not quite as readily. The exterior is coal black, not glossy but quite mat. They often contain a number of small stones; in one case one as large as a hen's egg was more than three quarters firmly embedded. Generally there were exhibited grooves resulting from enclosed roots, which in most cases, however, had rotted away. One of these grooves is plainly shown in the left-hand specimen of Plate 7. The external structure is not very definite, showing merely minute irregular fissures.

In cutting through a specimen, the knife frequently strikes embedded grains of sand and small stones. The crust of the

sclerotium differs in color perceptibly from the interior. There is a pronounced coal-black layer readily distinguished from the interior substance. The bark seems structureless in our specimens; on microscopical examination one finds but the debris of what might have been originally specialized hyphae.

The interior is blackish olive green, particularly when fresh, becoming more grayish black when dry, but its appearance on the whole is black, interspaced with many small crevices which are filled with dirty, white, very tough masses of hyphae. This gives the interior a mottled, marble-like effect. (Plate 7, center.)

Microscopically examined, the hyphae are of very irregular thickness. They are thick-walled and show numerous curious hooks and clamps and an occasional anastomosis. (Plate 9*A*.)

The darker substance, which resembles rubber, evidently also consists of hyphae, considerably thicker and almost solid when moistened. The difference in size between the hyphae composing the light and dark masses, is plainly shown in our attempt to interpret the interior structure of these sclerotia. (Plate 9*B*.)

When thoroughly dry, the sclerotia became as hard as stone and once they had dried out would not produce any fruiting bodies, but merely decomposed when buried in the soil.

The habitat of these sclerotia is invariably among the roots of poplar woods. They are found generally after land has been cleared and the ground backset afterwards by the plough. Correspondents frequently report having seen them attached to roots. This has given rise to the statement that they might be parasitic. The wood to which the sclerotia are attached is filled with hyphae, but we have no first-hand evidence that they derive more benefit from being attached to a root—although there exists such probability—than from the stones with which they are often intimately associated.

The next striking statement is that these bodies are edible, but we ourselves could not exert any marked effect on them with our teeth, though in the interests of mycophagists we tried them raw and cooked. Cooked, they became slightly jellified, but a jelly itself was not produced.

The late James Fletcher (1) gave a preliminary account of his

observations with what we are confident were sclerotia similar to our own. Dr. Fletcher planted some of these sclerotia in 1906, and a year later he had the great satisfaction of finding two fleshy "toadstools" growing from the sclerotia, which he stated he had so far not identified. He gave a very brief description of the fungi, and referred them to the genus *Polyporus*. The photographs which accompany his note unfortunately show nothing beyond the fact that the sclerotia produced fruiting bodies. Similar success attached to some specimens of the same consignment which Professor Thaxter planted. His, also, after being planted two years, yielded a fruiting body, a form of *Polyporus*, which he turned over to Dr. Farlow.

Dr. Farlow mentioned in this connection a popular article by J. H. Gore (2) dealing with a Southern Tuckahoe or "Indian Bread." The fungus dealt with by Gore is obviously not the same as ours.

Some time ago, on August 1, 1914, we planted a sclerotium recently received, and in splendid condition, which produced ten months later a fruiting body. The sclerotium in question weighed about 13 ozs. and came from Manitoba, where it had been dug up in a field formerly a poplar bush; it was planted in a nine-inch flower pot about three inches below the soil surface and the pot was embedded in the ground outdoors. Towards the beginning of June, 1915, we observed a small fungus body developing. This grew to the size of a filbert and then died. A few days later another more vigorous fruiting body made its appearance, but so close to the edge of the pot that we feared its shape would be affected. So far as we could observe without disturbing the specimen, the margin of the cap was but slightly incurved. Towards the end of June the sporophore had matured and began shedding large masses of white spores (Plate 8).

The cap was almost sessile, the stem proper being only about half an inch above ground.

The surface of the cap measured 5 inches by 3½ inches. The pileus was thick, soft fleshy, like cheese in texture, and irregularly lobed, with one particular prominent imbricate lobe. This made the stipe appear almost eccentric. The pileus was at first hemi-

spheric to convex, but later became plano-convex with slightly upturned margin, exposing the tubes of the hymenium. The surface was dry, soft and silky to the touch. The flesh was thick in the center, whereas the margin or edge was decidedly thin, only about $\frac{1}{16}$ of an inch, whilst the tubes towards the edge were nearly $\frac{1}{4}$ of an inch in length.

The color of the pileus was at first light brown but became buff to ochraceous with age. The surface appeared covered with minute, dark buff scales. The margin was very definitely of lighter color than the rest of the cap. (See figure of pileus, Plate 8.)

The hymenium was dusty from the spores, but otherwise almost the same color as the cap, but slightly grayish, very soft and moist as in some Boleti. The tubes were large, angular to sinuous, nearly twice as long as broad, and later on appeared shallow and the pores lacerated. The tubes are longest towards the dome of the pileus, but become shallow towards the stem, almost resembling reticulations as they become decurrent.

The spores are hyaline, white in a mass, smooth, often narrow in the middle, but generally ovoid to ellipsoid, with one to several little oil globules. The average size is $10–17\,\mu$ by $4–7\,\mu$.

The stem is solid, compound to branched, almost entirely below ground, rising from a solid sclerotium. Only about half an inch of the stem in our specimen showed the same color as the tubes, the rest was covered with soil particles firmly held. It was about $2\frac{1}{2}$ inches long by $\frac{1}{2}$ an inch thick. Length no doubt is determined by the depth the sclerotium is buried.

These notes have been taken from only one living specimen seen, and are as accurate as they could be made, but which of the characters referred to are permanent and specific, and which may vary, can only be determined from a series of specimens. It is interesting to record that while we may come across many references to sclerotia-bearing fungi in literature, yet the descriptions of any of those resembling our specimens are meager and indefinite.

Beginning, for instance, with Fries' *Pachyma cocos,* to which nearly all authors refer the term Tuckahoe, we cannot identify

our fungus as *Pachyma* in the absence of any fructifications known in his fungus; moreover our sclerotia were never white nor fleshy within.

The "native" or "black fellows" bread (3) of Australia and Tasmania (*Polyporus Mylittae* Mass.) also disagrees in description with our specimen. Then there is the specimen of Möller from southern Brazil, *Polyporus Sapurema,* with a sclerotium up to 40 lbs. in weight, apparently quite different from the Canadian specimen (4).

In Italy, "pietra fungaia," or the sclerotium of the fungus *Polyporus tuberaster* (Jacq.) Fries (5), seems to have received the most attention and excellent descriptions have been made. For a reference to the latest description of this fungus (6) we are greatly indebted to Professor Farlow, who with usual courtesy was good enough to copy for us the description therein given.

While our fungus is close to *P. tuberaster,* our sclerotia apparently differ very greatly from those of the former. The tubes in our form were never white, but yellowish from an early stage. The pores in our specimen are large and angular, in *P. tuberaster* small and round, though later becoming angular.

C. G. Lloyd (7), who speaks of specimens he has seen in Europe, states that *P. tuberaster* does not really have a true sclerotium. The hard masses are formed of earth, cemented into a stone-like body by the mycelium of the fungus. In this connection all descriptions of the sclerotia of *P. tuberaster* agree, but our sclerotia are quite different in structure and do not in any way resemble masses of earth cemented by fungus mycelium. We have occasionally observed masses of this description, some more like a sclerotium than others, but all of them altogether different from the Canadian Tuckahoe.

From a general survey of the forms to which this polypore may be referred, it would seem that the European *P. cristatus* Fr. bears considerable resemblance to it.

C. G. Lloyd, with usual candor, places himself on record as considering *P. cristatus* as probably identical with the American species *P. flavo-virens* Berk. et Rav., to which our form certainly comes very close.

Some authors are inclined to include *P. tuberaster* and *P. Sapurema* with *P. flavo-virens.*

At any rate we feel fairly confident in referring our fruiting body to the genus *Grifola* as revised by Murrill (8), since the generic characters agree satisfactorily.

The question of species is much more difficult; it would seem that the specific characters of this fungus do not agree with those of any of the species given by Murrill under *Grifola.* Later and more complete descriptions only, will settle some minor points. We regard our specimen as deserving specific rank, and in order to connect the Indian term Tuckahoe definitely with the fungus that has been grown from several of them, it is proposed to tentatively name it *Grifola Tuckahoe,* with the following brief diagnosis:

Grifola Tuckahoe sp. nov.

Pileus fleshy, stipitate, lobed to imbricate, convex to plano-convex, 7–13 cm. (and more) in diameter, ochraceous to buff tawny, covered with minute dark scales on surface. Flesh soft, thick, light yellow to brown. Stipe central (to lateral), short, stout, compound. Tubes ochre to yellow brown, large, angular to sinuous, shallow and decurrent towards stipe, lacerate with age. Spores hyaline, guttulate, ovoid to ellipsoid, 4–7 μ by 10–17 μ, grayish-white in mass.

Habitat in poplar woods of Manitoba and Saskatchewan, growing from large coal-black rubber-like sclerotia, popularly known as Tuckahoe.

CENTRAL EXPERIMENTAL FARM,
OTTAWA, CANADA.

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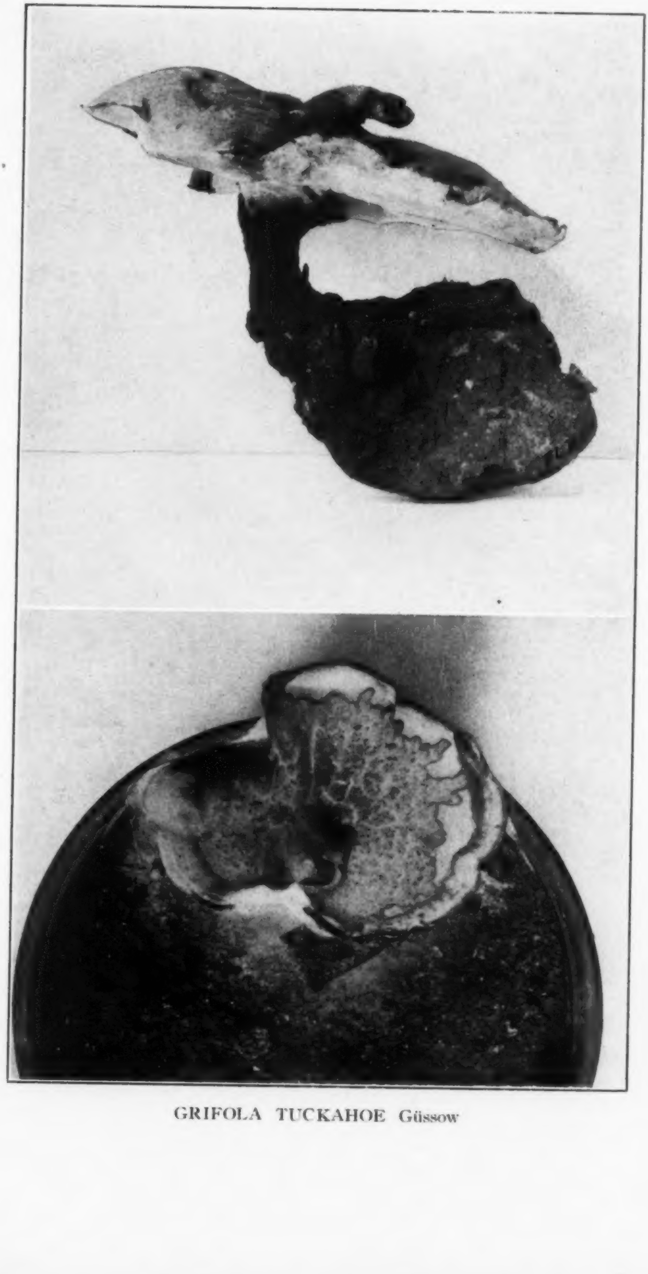
EXPLANATION OF PLATES

Plate 7. Underground sclerotia of the Canadian Tuckahoe (*Grifola Tuckahoe* Güssow). Left specimen showing groove resulting from attachment to root. Central specimen, portion of sectional sclerotium. The largest specimen shown weighed 8 lbs. 4 ozs.

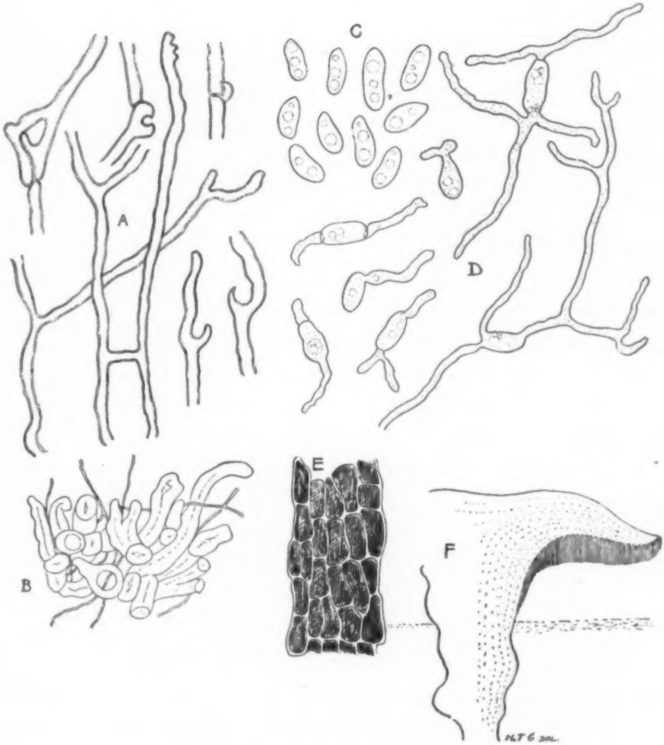
Plate 8. Fruiting bodies growing from sclerotium of Tuckahoe.

Plate 9. *A,* Mycelial hyphae from interior of sclerotia showing hooks and clamp cells; *B,* structure of black substance of sclerotium showing size of the two mycelia present; *C,* spores of *Grifolia Tuckahoe; D,* germination from one to four days; *E,* pores of hymenium; *F,* diagram showing relative size of tubes to pileus.

GRIFOLA TUCKAHOE Güssow



GRIFOLA TUCKAHOE Güssow



GRIFOLA TUCKAHOE Güssow

SOME DISEASES OF TREES IN GREATER NEW YORK

Arthur Harmount Graves

(With Plate 10, Containing 4 Figures)

In the course of field work carried on by the writer in Greater New York and the adjacent parts of New Jersey in the summer of 1918, several diseases of forest trees were incidentally studied: those selected for the present paper are important on account of their destructiveness, or interesting by reason of their rarity, or demand attention because they are little understood and need further investigation. A few notes on injury from the extremely disastrous winter of 1917–1918 are added.

The writer wishes to acknowledge his indebtedness to the many persons, some of them named in the text of this paper, who have contributed information or assistance toward its preparation; and to the botanical staff of Yale University for generously placing the Osborn Botanical Laboratory at his disposal for the culture and microscopic work involved.

The diseases are arranged according to host species, the sequence of hosts following that of Sudworth's Check List of the Forest Trees of the United States.[1]

I. Bark Disease of the Butternut (*Juglans cinerea* L.)

Almost without exception the mature butternut trees in the region surveyed were in a moribund condition, sometimes only a few of the smaller branches being dead, while in extreme cases the entire tree had succumbed. Usually the disease appeared to commence on the branches, both those at the top of the tree as well as at the sides of the trunk being affected. During the death of the distal portion of a branch another would develop further

[1] Sudworth, George B. Check list of the forest trees of the United States. U. S. Dept. Agr., Forest Service Bul. 17: 1–144. 1898.

down as a side shoot: this would be eventually killed in its turn, another would arise further down, etc. Thus, while the distal portion of the branch was dead and often entirely devoid of bark, living shoots could be found below. Eventually the whole branch would die and others, sometimes appearing at the branch axil at the trunk would be killed in their turn. It seemed as if the disease entered the trunk in this way, via the dead branches, the death of those at the top of the tree causing a stagheaded aspect characteristic of the disease. Only in a few cases was a prominent crown of suckers observed on the trunk such as occurs in the chestnut bark disease. However, the large number of new branches, mainly orthotropous, which had arisen in the manner described, marked the affected trees in a distinctive manner. Eventually, the death of the whole tree ensued.

That the progress of the disease was slow was indicated, among other things, by the fact that no sudden wilting of the leaves occurred on the affected parts. Moreover, the writer has observed trees in the neighborhood of New Haven, Conn., afflicted with this trouble, or something very similar, for a number of years, and they are not yet entirely dead. It is significant that butternut fruits have been scarce about New Haven for many years.

Dr. G. P. Clinton says that he has noticed the trouble for a number of years, and while he has not investigated it carefully, has had the general impression that the cause is to be looked for in a general decline in the vigor of the host species, just as he believes is the case with the American chestnut and with *Hicoria*. Mr. J. J. Levison, formerly N. Y. City forester, and now consulting forester at Sea Cliff, L. I., states that he has also noticed the disease for some years. Last summer the writer saw affected trees in Pennsylvania and Maryland, and this winter at West Hartford, Conn. Apparently the disease is widespread.

There was no evidence of insect injury about the trees, but wherever it was possible to examine closely one of the diseased limbs the fungus *Melanconium oblongum* Berk. was conspicuous on the dead bark, and often in the immediate vicinity of the healthy tissue. The diseased inner bark was much blackened and formed a strong contrast to the light colored healthy inner bark, the line of demarcation between the two being very clearly defined.

Melanconium oblongum Berk. has been collected many times in the U. S., but almost entirely, so far as the writer can ascertain, on *Juglans cinerea*.[2] Berkeley first described it from specimens from the United States in 1873–4.[3] From an examination of published descriptions of *Melanconium* species and from a study of exsiccati we suspect that the organism has several aliases, but until the criminal evidence is more conclusive it is not worth while to discuss them here. Dr. Shear collected the fungus in 1893 in close association with *Diaporthe juglandis* E. & E., and according to a note by him in the herbarium of the N. Y. Botanical Garden, he believed the latter species might be the perfect form of *Melanconium oblongum*.

The spores of the fungus are brown, elliptical-oblong, with homogenous granular contents, or often containing one or more drops or vacuoles, and measure about 20 μ in length.

It is possible that the fungus may prove to be a slow parasite, but of course the only evidence in support of this is its constant association with the disease. However, another species of this genus, *Melanconium sacchari*, is usually accredited with being the causal agent of a destructive disease of sugar cane.[4] There is need of further work, particularly inoculation experiments, to throw light on the question.[4a]

II. Nectria Canker of the Sweet Birch (*Betula lenta* L.)

This was easily to be reckoned the most destructive disease of the sweet birch in the New York area, and is causing a great deal of damage. The writer has had the trouble under observation since 1909, having first observed it in a forest at Orange, Conn.

[2] Collected by Ellis at Newfield, N. J., on *Juglans regia*, 1892. The writer has made an effort to find the fungus on *Juglans nigra* L., but without success.

[3] Berkeley, M. J. Notices of North American fungi. Grevillea **2**: 153. 1873–4.

[4] Cook, Mel. T. The diseases of tropical plants. Pp. 81 ff. New York, 1913.

[4a] Healthy twigs of butternut, brought into the greenhouse in March, 1919, and inoculated from a pure culture of the fungus, had, on April 26, as this paper is going to press, developed 33 infections out of 59 inoculations. 19 of these 33 showed spore pustules of *Melanconium oblongum*. Checks remained uninfected. A similar series on black walnut gave negative results.

In the New York region, no tract where *Betula lenta* formed a fair per cent. of the stand was free from the disease. In the fall of 1918 a forest at Milford, Conn., was visited, where about 50 per cent. of the stand was sweet birch, and at least 90 per cent. of the trees were affected. Dr. G. P. Clinton states that he has noticed the trouble for many years, and showed the writer specimens collected on *Betula lenta* near New Haven in 1906. The writer collected specimens of the causal fungus, *Creonectria coccinea* (Pers.) Seaver (*Nectria coccinea* Fr.) from trees in Van Cortlandt Park, Mt. St. Vincent, Staten Island, and the terminal moraine north of Hollis, L. I., but the disease was seen in many other localities.

The symptoms are typical lipped cankers, which if old are open, but in a younger stage may be still covered over with dead bark and then only appear as sunken spots with the bark cracked at the margins. Usually several cankers appear on a single tree, distributed at irregular intervals along the trunk and branches. Branches even as small as ½ inch in diameter may have the cankers, and such lesions, from their characteristic, irregular, nodular appearance, may be recognized readily from a distance. The fungus advances in the living bark during the season of inactivity of the host. Thus, during October, November and early December, and again in early spring, the new bark recently killed by the fungus can easily be observed by cutting in at the margins of the canker. The freshly diseased cortex has a sodden consistency and a dark reddish hue, contrasting sharply with the yellow color of the healthy inner bark, while at the boundary between the two a dark red line appears. With the new season's growth of the cambium, the inroads of the fungus are temporarily checked, to be resumed again in the fall. In this way the successively receding layers of wood about the canker are formed. The disease thus progresses slowly, and in many cases may be present in the tree for a long period, the increase in circumference of the tree more or less compensating for the loss of cortex through the fungous attack. One large tree, about 2½ feet in diameter, breast high, near Whitestone, L. I., was seen which had been affected apparently for many years, one of the cankers, near the

base of the trunk, being about 1½ feet in diameter. Often, however, trees are eventually killed out, especially if due to suppression their diameter growth is slow.

The fruiting bodies, or perithecia, begin to ripen in August; and although some were found to contain mature spores by the end of the month, in most cases the spores are not ripe until the latter part of September or in October. During the winter it is possible to obtain ripe fruiting bodies on almost any canker. Sometimes these are few and very inconspicuous, being scattered about singly or in twos or threes in crevices in the bark; but occasionally their aggregation in groups makes them readily visible. But even where very few, they can be easily detected with the naked eye (being a little less than .5 mm. in diameter) appearing as small, bright crimson dots, located on the diseased bark, not far from the border line of healthy and diseased tissue. In shape the perithecia are ovoid: 19 specimens taken from different sources measured $406 \times 288\,\mu$.

The ascospores are colorless, two-celled, and when ripe, often show pronounced constriction at the septum. The majority of the specimens examined were very blunt or rounded at the ends when mature, although many were fusoid, and in the younger stages they were always fairly sharp pointed. Measurements of 75 spores from various sources, averaged $14.5 \times 7.5\,\mu$. These figures agree with those given in the North American Flora,[5] except that our spores are a little wider. But Dr. Seaver, to whom specimens were submitted, says that there is no doubt that it is *Creonectria coccinea* (Pers.) Seaver.

Macroconidia developing from pure cultures on oat agar were yellow in mass, transparent when viewed under the microscope, averaging about $70 \times 6\,\mu$, blunt at the ends and with 5 to 8 septa —usually 7. They are slightly curved, and usually a trifle thicker toward one end (Plate 10, fiig. 4, *a*).

Of exsiccati, N. A. F. 161, *Nectria coccinea* Fr. collected at Newfield, N. J., on bark of dead *Magnolia*, showed spores averaging about $16 \times 5\,\mu$, without constrictions. Fungi Col. 2043, *Nectria coccinea* Fr., on *Tilia americana*, London, Canada, showed

[5] Seaver, F. J. Hypocreales, in North American Flora 3^1: 21. 1910.

spores about $14 \times 5\,\mu$ and also without constrictions. These are nearer the figures given in the North American Flora.

Although this fungus, under the name of *Nectria ditissima* Tul., is presumably the cause of the "European apple-tree canker" in North America,[6, 7, 8] we have found no reference to it as a pathogenic organism on forest trees in North America, if we except the paper by Pollock,[9] in which he speaks of a fungus resembling *N. coccinea*, associated with a canker of the yellow birch (*Betula lutea* Michx. f.) in Michigan. Many points in his description coincide with the facts set forth above. In particular, his spores agree with ours in that they are wider than the figures cited in the type descriptions. Perhaps the variation in form is due to the influence of the host. Cook[10] has reported a *Nectria* parasitic on the Norway maple, but was unable to determine the species with certainty. In correspondence with the writer he has stated that it was probably *Nectria cinnabarina*.

As already intimated, *Nectria ditissima* Tul. as well as *N. coccinea* Fr. are considered synonyms of *Creonectria coccinea* (Pers.) by Seaver in the treatment in North American Flora. Yet there still seems to be some confusion as to just what is meant by *Nectria ditissima* Tul. Seaver[11] says: "So far as we can see the species (*Creonectria coccinea*) scarcely differs from *Nectria ditissima* Tul. If the two species are distinct, the characters are so poorly understood that they have been badly confused." We have for a long time been accustomed to regarding *Nectria ditissima* Tul. as the causal fungus of the canker of deciduous trees in Europe. And yet, according to Shear,[12] Euro-

[6] Wilson, G. W. Notes on three limb diseases of apple. N. C. Agr. Expt. Sta. Rept. **35**: 49. 1913.

[7] Duggar, B. M. Fungous diseases of plants. Pp. 242–243. 1909.

[8] Morse, W. J. Spraying experiments and apple diseases in 1913. Me. Agr. Expt. Sta. Bul. **223**: pp. 23–24. 1913.

[9] Pollock, J. B. A canker of the yellow birch and a Nectria associated with it. Mich. Acad. of Sci. Rept. **7**: 55–56. 1905.

[10] Cook, Mel. T. A Nectria parasitic on the Norway maple. Phytopath. **7**: 313–314. 1917.

[11] Seaver, F. J. The Hypocreales on North America. Mycologia **1**: 188–189. 1909.

[12] Shear, C. L. Some observations on phytopathological problems in Europe and America. Phytopath. **3**: 80 ff. 1913.

pean mycologists have recently stated that the fungus causing the apple canker in Europe has been incorrectly identified and is not *Nectria ditissima* Tul. but *Nectria galligena* Bres., a fungus which has not been reported from this country. It seems probable, therefore, that the true European Nectria canker does not occur here." No exsiccati of *N. galligena* Bres. have been available for examination, but the description by Wollenweber[13] agrees with our form in all points, especially as regards ascospores and macroconidia.

Without entering into further discussion, it would seem to the writer very desirable that a comparative study involving both cultural and infection methods be carried on for *Creonectria coccinea* and *Nectria galligena* to determine whether they are really distinct.

III. WINTER INJURY OR LEAF SCORCH OF THE BEECH (*Fagus atropunicea* (Marsh.) Sudw.)

Diseased or dying beeches were observed all over the region explored, particularly in Van Cortlandt Park, the Palisades of the Hudson and Staten Island. The most striking symptom was a reddish-brown coloration of the tips and margins of the leaves, and this often extended in irregular patches between the parallel veinlets characteristic of this leaf down to the midrib. In many cases the bark of the trunk and branches was quite sound; in others, whole branches were entirely dead, especially toward the top of the tree. No fungus was apparent on the leaves, nor was any pathogenic form discovered on the dead bark. All the evidence, therefore, pointed to a root trouble. If we take into consideration the very severe winter of 1917–18, there is no doubt that the extreme conditions occurring then killed out a portion, at least, of the roots. Whether these trees will recover or not depends on the relative amount of damage to the root system. All the dead branches should be pruned off and the living ones also cut back heavily in order that the tree may regain the balance

[13] Wollenweber, H. W. Ramularia, Mycosphaerella, Nectria, Calonectria. Eine morphologisch pathologische Studie zur Abgrenzung von Pilzgruppen mit cylindrischen und sichelförmigen konidienformen. Phytopath. 3: 197–242, *pl. 1–3.* 1913. See also another paper by the same author: Studies on the Fusarium problem. Phytopath. 3: 24–51. 1913.

between root and shoot system, and, in the balance account, perhaps have a little credit left on the side of the root system.

IV. HEART ROT OF OAK (*Quercus* spp.)

Three fungi of interest were observed causing heart rot of different species of oak, as follows:

1. *Globifomes graveolens* (Schw.) Murr.—In a forest of oak, sweet birch and red maple, near Mt. Loretto, Staten Island, a red oak (*Quercus rubra* L.), 16 inches in diameter, breast high, had recently been broken about 12 feet from the base and blown over, the freshness of the damage being attested by the wilted, green leaves. Scattered along the surface of the bark from the base of the tree to the breaking point at fairly regular intervals were four fine specimens of this fungus, an organism which is of rare occurrence in North America, and never before found in this locality. From a little distance it resembles a small beehive with one side more or less flattened and cemented firmly to the bark. On closer inspection it may be seen to consist of a large number of small, tightly overlapping, light to very dark gray sporophores of polyporaceous nature, all proceeding from a common center or core (Plate 10, fig. 3).

There is good evidence that the fungus is a facultative parasite, for where the wood was exposed by the break it was covered with a thin sheet of white mycelium which was connected with the sporophores. Investigation showed the heartwood to be infested everywhere with the mycelium, which, in spots, was encroaching on the sapwood also. The fruiting bodies were borne in furrows of the bark, perhaps in regions of old branches. The fungus had apparently gained entrance through a fire scar which extended 18 feet up the trunk.

That the fungus is also saprophytic is shown by collections in the herbarium of the New York Botanical Garden from dead hickory in Indiana, and from a dead stump in Delaware. Other collections at the Garden are from North and South Carolina; from Pennsylvania, Ohio and Iowa. It has been collected on living *Quercus coccinea* at Wilmington, Delaware, by Dail. The specific name was derived from its sweet odor, which, however, was not evident in our specimens.

2. *Inonotus hirsutus* (Scop.) Murr.—The rusty brown or chestnut colored, hairy surface of the pileus of this species, also commonly known as *Polyporus hispidus* Fr., distinguishes it from the nearly related species with a glabrous pileus, *I. dryophilus* (Berk.) Murr., which is the agent of a very destructive heart rot of oaks in the United States.[14] With age the rusty brown color may take on a black, carbonaceous hue, but usually some portion of the pileus still has a ferruginous cast. Moreover, old specimens often lose their dense covering of matted hairs, but are still quite roughened.

A tree of black oak (*Quercus velutina* Lam.) in a forest on Staten Island was found badly diseased, evidently through the action of this fungus. Commencing about 10 feet from the base of the tree were several elongated cankers extending upward for about 8 feet on the trunk and bearing fruiting bodies of the fungus on exposed diseased wood. The trunk was considerably hypertrophied in the region of the cankers, which were fairly close together, and thus a long, spindle-shaped swelling in the bole was formed—a condition which indicated the destruction of the inner wood by the fungus, and an attempted compensation for this by increased growth of the sapwood.

Dr. Murrill says that the species is rare in this country, but common and virulent in Europe and very destructive to shade trees there. The writer collected it on living European ash (*Fraxinus excelsior* L.) near Torquay, Devon, England, in 1915, and also observed it on the same host in 1914 near Rugby, Warwick. According to Prillieux[15] the parasite is not uncommon on mulberry trunks in France. The same investigator and Delacroix record it among the enemies of the English walnut (*Juglans regia* L.) in France.[16] Butler[17] states that it is destructive to

[14] Hedgcock, G. G. Notes on some diseases of trees in our national forests. II. Phytopath. **2**: 73, 74. 1912.

[15] Prillieux, E. Maladies des plantes agricoles **1**: 352. 1895.

[16] Prillieux, E., and Delacroix, G. Les maladies des noyers en France, Bul. de l'agricult. **1898**: 1–14. Ref. in Just's Bot. Jahresb. **26**[1]: 177. 1898.

[17] Butler, E. J. Mulberry diseases. Mem. Dept. Agr. India. Bot. Ser. **2**[8]: 1–18.

The writer has been able to find no reference to this fungus as a pathogen in the United States.

apples, plums, apricots and especially mulberries in Kashmir, India. It is found in the trunk, but also attacks the larger branches. Butler finds that the fungus enters branch scars where heart-wood is exposed, and says: "The tissues are little by little destroyed from within out, becoming soft, spongy and yellowish white. The trunk may be almost completely hollowed, but often a ring of still living wood is left which is sufficient to keep the crown green." In most cases the trees thus weakened are blown over before they are killed out entirely. This mode of action corresponds closely with the condition of affairs in the oak above described.

3. *Pyropolyporus Everhartii* (Ellis & Gall.) Murr.—A huge pin oak (*Quercus palustris* Muench.) at Englewood Heights, N. J., has attracted a good deal of attention for a number of years on account of numerous gnarly swellings which appear toward the base of the trunk. Each swelling was found to contain in some part of it young or old fruiting bodies of this fungus—also known as *Fomes Everhartii* (Ellis and Gall.) von Schrenk and Spauld.—indicating that the organism was the cause of the disturbance (Plate 10, fig. 1). The fungus had grown in the trunk for a long period of years, if one were to judge from the thickness of the bark and wood of which the swellings were composed.

That this species has parasitic habits has already been pointed out by Von Schrenk and Spaulding,[18] who found it of common occurrence on living black jack oak (*Quercus marilandica* Muench.) and determined that the mycelium of the fungus "was capable of growing into the sapwood of the living tree." Hedgcock[19] finds it causing a very destructive heart rot in a large number of species of oak in the United States and states that it is the cause of the most common and destructive heart rot of walnut, especially *Juglans rupestris,* although *J. nigra* and *J. californica* are frequently attacked. *J. cinerea* is apparently rarely attacked. Other hosts are *Prosopis juliflora* (Swartz) deC. the mesquite, *Fagus atropunicea* (Marsh.) Sudw. the beech, *Betula papyrifera*

[18] Von Schrenk, H., and Spaulding, P. Diseases of deciduous forest trees. U. S. Dept. Agr. Bur. Plant Ind. Bul. 149, p. 48. 1909.

[19] Hedgcock, G. G. L. c. pp. 74, 75.

Marsh, the paper birch, and other species of birch. Weir[20] records it on living trunks of *Populus trichocarpa* Torr. & Gr., the black cottonwood, in Montana.

The sporophores resemble closely those of *Pyropolyporus (Fomes) igniarius* (L.) Murr., but the spores of the latter are colorless, while those of this species are yellowish brown. Another distinctive feature seems to be the bright yellow color of the mycelium of which the pileus is composed. Dr. Murrill says that he also has used this bright color as a field character.

V. DISEASE OF THE WHITE OAK (*Quercus alba* L.)

All over Staten Island the white oaks of large size were found to be dying out. This was not due to the severe winter preceding, for Dr. Arthur Hollick, of the Staten Island Institute of Arts and Sciences, informed the writer that the trouble has been going on for several years. There was no patch of forest in which the dying and dead trees could not be seen on every hand. Rhizomorphs (possibly of *Armillaria mellea* (Vahl.) Quélet) were found under the bark of many, but not all trees. It seemed as if the larger trees were the ones that were affected. In some instances traces of a boring beetle were seen.

VI. BARK DISEASE OF THE PAPER MULBERRY (*Broussonetia papyrifera* Vent.)

Near Bayside, L. I., a large paper mulberry about one foot in diameter breast high, growing as a shade tree in a fr[illegible]d, was found badly diseased by *Creonectria purpurea* [illegible]er (*Nectria cinnabarina* Fr.) at the base of the trunk. The [illegible]tial pathogenicity of this species has been proven beyond [illegible]tion,[21] and there was no doubt here that the fungus was adva[illegible] in the living bark. And yet it is known to often lead a [illegible]ely saprophytic life on dead twigs.

[20] Weir, J. R. Montana forest tree fungi I. Polyporaceae. Mycologia 9: 135. 1917.

[21] Mayr, H. Über den Parasitismus von Nectria cinnabarina. Untersuch. a. d. Forstb. Inst. zu München. III. 1882

VII. BLIGHT OF SYCAMORE (*Platanus occidentalis* L.)

The blight of sycamore, caused by *Gnomonia veneta* (Sacc. & Speg.) Kleb. was seen in many places: practically no sycamore was free from it. The fungus appears to be a slow parasite, growing more especially during the early spring months during the period of dormancy of the host. When observed during the summer, the fungus had in all cases apparently ceased its growth, after killing terminal twigs here and there. This habit is probably largely responsible for the scraggly appearance of our sycamore trees.

VIII. HEART ROT OF LOCUST (*Robinia pseudacacia* L.)

The black locust is very common in the area under consideration, especially on Long Island. Its worst fungous enemy is *Pyropolyporus Robiniae* Murrill, which attacks the heart-wood.[22] The fruiting bodies are large, hoof-shaped structures, and are of common occurrence but do not attract attention because they are dark colored and usually high up on the trunk.

During the summer the depredations caused by the locust leaf miner (*Chalepis dorsalis* Thunb.) were conspicuous.

IX. INJURY FROM THE WINTER CONDITIONS OF 1917–18

In an account of the most important and interesting pathological features of the trees in the New York region, the effects of the severe winter of 1917–18 should by no means be omitted. It is entirely unnecessary for the writer to establish the fact that the winter was unprecedented, for that was perfectly clear to all at the time. What he would like to emphasize is that the combination or the chain of meteorological phenomena, aside from the mere fact of the extreme cold itself, was especially unfavorable for plant life. This cannot be better set forth than by quoting from Dr. Taylor.[23] After remarking on the extremely low temperatures toward the latter part of December, he con-

[22] Schrenk, H. von. A disease of the black locust. Mo. Bot. Gard. Rept. **12**: 21–31. 1901.

[23] Taylor, N. Effects of the severe winter on the woody plants in the garden. Brooklyn Botanic Gard. Record **7**: 83–87. 1918.

tinues as follows: "The first four days of the year showed minimum temperatures of $-5°$, $+2°$, $0°$, and $-3°$ respectively, and on January 12 the temperature was 50°. Worst of all, on the latter day, the velocity of the wind was greater here than in any other place in the country, the record showing maximum velocity of 84 miles an hour, from the southeast. The following of such extreme cold by a warm wind of this great velocity apparently played havoc with many valuable plants in the Garden. With the ground frozen to depths unknown before, as there was practically no snow covering during the coldest days, the root activity of most plants would be stopped, while the warm wind on the twelfth, when the maximum temperature for January was recorded, would dry out many evergreens, even if they had withstood the cold of a few days before. Because of this combination of cold temperatures followed by warm wind, it is perhaps impossible to ascribe all our losses to cold alone. Certainly one or the other, or most probably their combination, has had disastrous results. . . ."

Taylor found that in the Brooklyn Botanic Garden 28 kinds of plants were killed outright, 20 killed to the ground, 70 severely winter-killed, and 28 slightly winter-killed.

In Central Park, the writer saw hundreds of trees which had suffered severely from these conditions, some killed outright, and most of them damaged beyond possible recovery. Prominent among the victims were large numbers of handsome beeches, sycamore maples, silver, red and Norway maples, cut-leaved birches, white mulberry, sassafras, black cherry, American elm, basswood, Turkey and pin oaks, and many others. Along the walk south of the reservoir, which was exposed to the full force of a north wind across the water, nearly every tree was dead or dying. Horsechestnuts and oriental planes seemed to stand the test as well as any species.

The following points should dispel any doubt that the winter was responsible for these conditions:

1. A large *variety* of species was affected.
2. The worst destruction appeared in exposed localities.
3. The symptoms were characteristic of winter injury; i. e.,

a browning of the leaves, casting of the leaves, and developing of suckers.

That the damage was so extensive in Central Park is to be accounted for partly by the character of the soil, which for the most part is hard and packed with the tramp of many feet. This condition, coupled with the absence of leaf mulch, rendered both radiation and evaporation more rapid from the surface, and therefore cold and drought penetrated much more readily and deeply than would be the case in the normal forest, where the soil is a deep rich humus covered with a blanket of decaying leaves.

Of susceptible species noted in other places, the sweet cherry, *Prunus avium* L., was the most conspicuous, and trees of this species killed outright were a very common sight. *Liquidambar* trees at Mt. St. Vincent and on Long Island were also notable sufferers. Many *Ailanthus* trees and especially the Lombardy poplar—the latter in the marginal park between the Hudson and Riverside Drive—were entirely killed. It is interesting to recall that *Liquidambar* is here near the northern limit of its range.

NEW HAVEN,
CONNECTICUT.

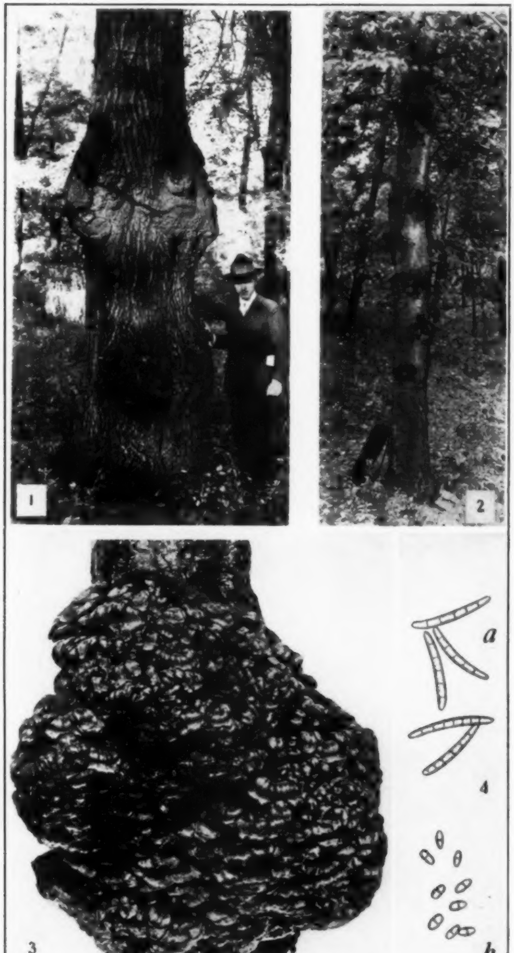
EXPLANATION OF PLATE

Fig. 1. Pin oak (*Quercus palustris* Muench.) at Englewood Heights, N. J., showing cankerous growths caused by *Pyropolyporus Everhartii* (Ellis & Gall.) Murr. This and the following photographs taken by Mr. Louis Buhle, Brooklyn Botanic Garden.

Fig. 2. Sweet birch (*Betula lenta* L.) with canker caused by *Creonectria coccinea* (Pers.) Seaver. On terminal moraine north of Hollis, L. I.

Fig. 3. Fruiting body of *Globifomes graveolens* (Schw.) Murr. from living red oak (*Quercus rubra* L.) in a forest near Mt. Loretto, Staten Island. One half natural size.

Fig. 4. Spores of *Creonectria coccinea* (Pers.) Seaver. *a*, macroconidia; *b*, ascospores. × about 300.



1. PYROPOLYPORUS EVERHARTII (Ellis & Gall.) Murrill
2, 4. CREONECTRIA COCCINEA (Pers.) Seaver
3. GLOBIFOMES GRAVEOLENS (Schw.) Murrill

A NOVEL METHOD OF ASCOSPORE DISCHARGE

D. Atanasoff

It has been generally observed that ascospores are discharged commonly from the apex of the ascus which ruptures at this point just before the ascospores are liberated. A few forms, such as *Claviceps,* have also been reported where the ascospores are discharged through the lower end of the ascus when it is torn from the perithecial base. A still different method of ascospore discharge, however, has recently been observed in certain *Pyrenophora* species. These have developed on the leaves and stems of *Bromus* and *Agyropyron repens* which earlier showed *Helminthosporium* lesions and are regarded as the perfect stages of these *Helminthosporium* species. *Pleospora herbarum* (Pers.) Rab., studied on various hosts has shown the same phenomenon. In these cases, the ascospore discharge is preceded by a modification of the ascus and the spores are then liberated from the side of the ascus.

Upon placing a mature perithecium having fully developed asci and ascospores in a drop of water on a microscope slide, the asci are readily liberated by slight pressure upon the perithecium wall and the ascospore discharge can be studied under the low power lens. The ascus wall in these species consists of two layers, the outer of which is thinner but more firm; the inner, much thicker and less firm. These two walls are not distinguishable, however, until the moment of ascospore discharge. When the ascus is liberated from the perithecium it begins to imbibe water. This seems to take place so rapidly that in a few seconds the ascus swells to one and one half times its original size. The pressure on the outer wall soon becomes so great that the latter ruptures at the apex of the ascus, contracts, and slips down toward the base with great rapidity. In some cases, however, all of this occurs less rapidly and can be easily followed under the micro-

scope. The ruptured outer wall contracts both in length and width. Soon the outer wall contracts at a point about one third of the distance up from the base of the ascus, thus forming a ring, while the ascus continues to swell by taking in more water. The pressure, partly released after the rupture of the outer wall,

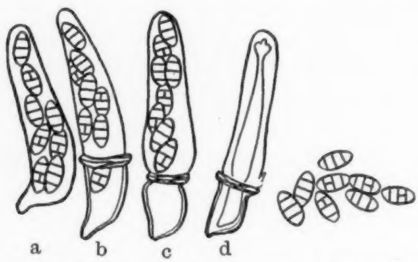


Fig. 1. Camera lucida drawing of an ascus of *Pyrenophora* in different stages of ascospore discharge, showing: *a*, normal ascus immediately after leaving the perithecium; *b*, outer wall ruptured and contracted in form of ring; *c*, ascus with all ascospores above the ring, pressure in ascus nearing critical point; *d*, discharged ascus with ascospores lying as thrown from ascus.

continues to increase until it reaches the critical point once more; the inner wall then ruptures, not at the apex, but just above the ring formed by the contracted outer wall, and the spores are thrown out with great force. Because of the resistance of the

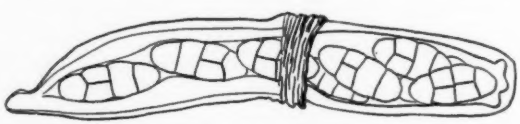


Fig. 2. Camera lucida drawing of ascus under high power, showing the two ascus walls, the outer ruptured and partially contracted, the inner much thickened and pressing upon the ascospores especially in the lower part.

water, they usually remain near the point of rupture of the inner wall, but that they are thrown out with great force is shown by the rapidity of their motion which is so great that it is very difficult to follow their exit from the ascus. The rapid shrinking of the empty ascus after the discharge of spores corroborates this point.

The ascospores before and during the swelling of the ascus are distributed uniformly throughout the ascus. After the formation of the ring, however, partly because of the rupturing and contraction of the outer wall, but more particularly because of the thickening of the inner wall, especially in the lower part of the ascus, there seems to be an upward movement of the ascus contents and usually before the breaking of the inner wall all ascospores are above the ring. Occasionally it was observed that single spores remained below the ring, but such spores usually remain inside the ascus even after the breaking of the inner wall.

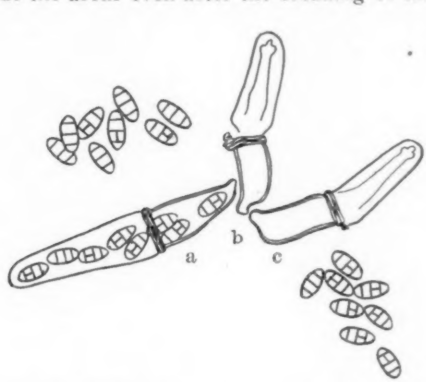


Fig. 3. Camera lucida drawing of group of asci, showing: *a*, swollen ascus with contracting outer wall; *b* and *c*, ruptured asci with ascospores lying as discharged.

Only in very rare cases, mostly in improperly developed asci, are there any spores left in the upper part of the ascus after the breaking of the inner wall.

The time that elapses from the moment of the liberation of the ascus from the perithecium to the time of its swelling and the rupturing of the outer wall varies considerably. It may take only a few seconds (15–30) or even several minutes or longer. The length of the time that elapses from the rupturing of the outer wall to the rupturing of the inner wall varies also. In some cases it is less than 30 seconds; in others it may be as long as 30 minutes.

Pfeffer in his "Physiology of Plants," 2d edition, v. 3, pp. 149–150, fig. 34, has described a case of ascospore discharge which resembles the above only in the behavior of the outer wall. Here the inner wall, instead of breaking above the ring formed by the outer wall, breaks at the top, and the spores are discharged not all at once but one by one. First one spore takes its place immediately at the apex, the inner wall breaks at that point, and the spore is thrown out. The next spore closes the opening of the inner wall and remains there until the pressure inside of the ascus becomes great enough to cause ejection. After this spore is thrown out, the next one takes its place and so on.

The method of ascospore discharge described here for some *Pyrenophora* and *Pleospora* species is the only method of ascospore discharge observed by the writer for these fungi. The material studied was gathered at different times throughout the spring and summer of 1918, and also during the early part of February, 1919, from different localities around Madison, Wis.

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CULTURES OF HETEROECIOUS RUSTS IN 1918

W. P. Fraser

While making a field survey in western Canada of the rusts which attack cereals, a number of grass and sedge rusts were collected, and a few cultures which field observations suggested were undertaken. These cultures were carried on in a well-lighted room in the Dominion Laboratory at Brandon, Man.

The methods of inoculation were those commonly employed. When teliosporic material was used it was placed in a moist chamber until the teliospores were germinating, when it was suspended above the plants used in the cultures. The plants and teliosporic material were then sprayed with water by means of an atomizer and covered with a bell jar for about 48 hours. When aesciosporic material was used the fresh aesciospores were transferred with a flat needle to the leaves of the culture plants and in addition the parts bearing aecia were suspended above so that the aesciospores would fall on the plants used in the culture. They were then sprayed and covered with a bell jar as in the case of the teliosporic experiments. Checks were kept which in all cases remained free from infection.

Uromyces Alopecuri Seym.

Aecia on *Ranunculus Macounii* Britton were often found associated with this rust on *Alopecurus aristulatus* Michx., so that the connection of the aecia was clearly indicated. On June 16th, two pots of *Alopecurus aristulatus* and one each of *Agropyron tenerum* Vasey and *Hordeum jubatum* L. were inoculated with fresh aeciospores collected at Brandon, Man. Uredinia began to appear on the pots of *Alopecurus* on June 23, and eventually aeciospores developed abundantly, followed later by telia. There was no infection of the other grasses. Collections of aecia were

also made on *Ranunculus sceleratus* L. in the vicinity of the rusted *Alopecurus* which doubtless belong here.

Orton (Mycol. **4**: 194. 1912) discusses the correlation between certain species of *Puccinia* and *Uromyces* and gives a number of examples of correlated species. *Uromyces Alopecurus* is clearly correlated with *Puccinia perplexans* Plow. (now usually placed with *Puccinia Agropyri* E. & E.) on *Alopecurus pratensis* L. Cultures by the writer (Mycol. **4**: 179. 1912) showed that *Puccinia perplexans* has aecia on *Ranunculus acris* L.

PUCCINIA ANGUSTATA Peck

Observations in the field clearly indicated that aecia on *Mentha canadensis* L. were connected with a rust on *Scirpus atrovirens* Muhl. Viable teliosporic material was collected at Brandon in the spring and two pots of *Mentha canadensis* were inoculated on May 28. Pycnia became evident on June 3 and aecia on June 10, infection being very abundant. Dr. Arthur determined the rust as *Puccinia angustata* Peck and pointed out that the aecia had been confused with the aecia of *Puccinia Menthae* Pers. notwithstanding they are much smaller and paler in color. Collections of aecia on *Mentha canadensis* belonging to this species were made later in the season at Dauphin, Man., where they were quite common.

Dr. Arthur has shown many times that this rust also has aecia on *Lycopus* (Bot. Gaz. **35**: 15, 21. 1903. Jour. Mycol. **8**: 53, 54. 1902, **11**: 58. 1905; **12**: 15. 1906; **14**: 13. 1908. Mycol. **1**: 223. 1909; **2**: 224. 1910; **4**: 54. 1912; **7**: 70. 1915). This experiment, however, establishes for the first time connection with aecia on *Mentha*.

PUCCINIA PHRAGMITIS (Schum.) Koern.

This rust was collected on *Phragmites communis* Trin. at Dauphin, Man. Wintered teliosporic material gave excellent germination and inoculations were made on plants of *Rumex*. Pycnia and aecia developed in abundance. The species of *Rumex* used in the culture could not be determined but it probably was *R. occidentalis* Wats. Collections of aecia were made

on *Rumex occidentalis* Wats. and *R. mexicanus* Meisn. in the field in the vicinity of the rusted *Phragmites* which belong to this species. Dr. Arthur (Bot. Gaz. **29**: 269. 1909. Jour. Mycol. **9**: 220. 1903; **14**: 15. 1908. Mycol. **2**: 225. 1910; **4**: 54. 1912) has conducted several successful cultures with this species.

PUCCINIA IMPATIENTIS (Schw.) Arth.

Aecia were found abundantly on *Impatiens biflora* Walt. at Dauphin, Man., and field evidence strongly suggested their connection with a rust on *Hordeum jubatum* L. On July 15 three pots of *Horedum jubatum* and one of *Triticum vulgare* L. were inoculated with fresh aeciospores. Uredinia were noticed on all the pots of *Hordeum jubatum* on July 25 and an abundant development of urediniospores followed. Telia began to form on August 2. The leaves of wheat flecked but there was no development of uredinia.

Further study is necessary to determine the systematic position of this rust, but it seems best for the present to place it with *Puccinia impatientis* which Arthur (Bot. Gaz. **35**. 18. 1903. Jour. Mycol. **10**: 11. 1904; **11**: 57. 1905. Mycol. **2**: 226. 1910) has shown to have aecia on *Impatiens* and telia on *Elymus*. It is very common on *Hordeum jubatum* in northern Manitoba.

PUCCINIA AGROPYRI E. & E.

In the vicinity of Brandon in many places aecia were common on species of *Thalictrum*. Field evidence indicated very strongly their connection with a sub-epidermal rust on *Bromus ciliatus* L. and B. *latiglumis* (Shear) Hitchc. There was also some evidence of connection with *Puccinia Agropyri* E. & E. on species of *Elymus* and *Agropyron*. On June 18 inoculations were made with aesciospores from *Thalictrum dasycarpum* Fisch. & All. collected at Brandon on the following grasses: *Elymus canadensis* L., *E. virginicus* L., *Agropyron tenerum* Vasey, *A. Richardsonii* Schrad., *Hordeum jubatum* L. and *Triticum vulgare* L. Uredinia appeared on *E. canadensis* on June 30, followed by telia on July 20. On *E. virginicus* uredinia were noticed on June 28 and telia by

July 11. *Hordeum jubatum* showed a slight infection, uredinia appearing on July 3, but telia were not formed, the plants not being healthy. There was no infection of the other grasses. On June 24, *Bromus ciliatus* was inoculated and uredinia were noticed on July 3 and telia by July 8, both were produced in great abundance.

Examination showed the rust on *Bromus*, both the field and culture collections, to possess teliospores very variable in size, shape and number of cells, only rarely could two-celled spores of the *Puccinia* type be found, practically all of the spores being three to several celled, some having as many as sixteen cells. The teliospores on *Elymus* were typical of *Puccinia Agropyri*, both those developed from the culture and field collections, though a few were three or more celled.

As Long (Jour. Agr. Res. **2**: 303. 1914) has shown that the host plant affects the morphological character of the spores in *Puccinia Ellisiana* Thuem. it was thought possible that the rust on *Bromus* and *Elymus* might be identical though showing such marked morphological differences in the teliospores. To test this, inoculations were made with the urediniospores from the culture on *Bromus ciliatus* on the following grasses: *Elymus virginicus* L., *Agropyron tenerum* Vasey, *A. Smithii* Rydb., *A. repens* (L.) Beauv. and *Hordeum jubatum* L. There was no infection of any of the grasses so it seems probable that the form of *Bromus* is biologically distinct, and that the plants of *Thalictrum* used in the culture bore two kinds or strains of aecia, one capable of infecting *Bromus* and another which infected *Elymus, Agropyron* and *Hordeum*.

Trelease (Jour. Mycol. **1**: 14. 1885) described a subepidermal rust on *Bromus* as *Puccinia tomipara* Trel. on account of some of the teliospores being three to several celled. Lagerheim placed this species in the genus *Rostrupia* on account of the several celled teliospores. Arthur (Mycol. **7**: 74. 1915) regards the group of subepidermal forms passing under various names with telia chiefly on *Agropyron, Elymus* and *Bromus* and aecia on Ranunculaceous hosts as forming one species. This includes *Puccinia tomipara* Trel.

The marked morphological departure from the *Puccinia* type by the teliospores of the *Bromus* rust used in the culture, make it doubtful whether it should be included in the genus *Puccinia.* The character seems fixed as many collections made at Brandon showed this character, as well as collections made on *Bromus latiglumis* (Shear) Hitchc. at Brandon, and Morris, Man. As its other characters and life cycle show a close relation with *Puccinia Agropyri,* it seems best to include it here until further study determines its true position.

SUMMARY

Uromyces Alopecuri Seym. Aeciospores from *Ranunculus Macounii* Britton infected *Alopecurus aristulatus* Michx.

Puccinia angustata Peck. Teliospores from *Scirpus atrovirens* Muhl. infected *Mentha canadensis* L.

Puccinia Impatientis (Schw.) Arth. Aeciospores from *Impatiens biflora* Walt. infected *Hordeum jubatum* L.

Puccinia Phragmitis (Schum.) Koern. Teliospores from *Phragmitis communis* Trin. infected *Rumex* Sp.

Puccinia Agropyri E. & E. Aecispores from *Thalictrum dasycarpum* Fisch. & All. infected *Elymus canadensis* L., *E. virginicus* L., *Hordeum jubatum* L. and *Bromus ciliatus* L. Uredospores from *Bromus ciliatus* L. failed to infect *Elymus virginicus* L., *Agropyron Smithii* Rydb., *A. tenerum* Vasey, *A. repens* (L.) Beauv. and *Hordeum jubatum* L.

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NORTH AMERICAN RUSTS ON CYPERUS AND ELEOCHARIS[1]

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The rusts inhabiting the species of the genus *Carex* have received considerable attention from both taxonomic and cultural viewpoints. The most recent accounts recognize in North America twenty-three species of *Carex* rusts, four with 1-celled teliospores (*Uromyces* or *Nigredo* type)[2] and nineteen with 2-celled teliospores (*Puccinia* or *Dicaeoma* type).[3] The rusts of other sedges have been studied much less carefully. Although *Cyperus* and *Eleocharis* are smaller and less variable genera than *Carex* it has not seemed reasonable that their rust flora should be so much more meager in North America as to consist of but three species on the two genera, yet this has been the generally accepted situation up to the present time. All specimens of rust on *Cyperus* have been called *Puccinia Cyperi* or *P. canaliculata,* these names being considered synonymous, while on *Eleocharis* 1-celled teliosporic forms have been called *Uromyces Eleocharidis,* and 2-celled forms *Puccinia Eleocharidis.*

Cyperus is a genus of about 600 species with a considerable distribution in the tropics whereas the genus *Carex* has something over 1,000 species chiefly distributed in temperate regions. *Eleocharis* is a much smaller genus. It is made up of about 140 species, rather widely distributed.

With the facts in mind as to the relative importance of the genera *Cyperus* and *Eleocharis* it was anticipated that a careful study of their rusts would reveal the presence of some additional

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[2] North American Flora **7**: 234–236. 1912.

[3] Mycologia **9**: 205–238. 1917.

species. There have been available about 300 collections (211 on *Cyperus* and 82 on *Eleocharis*) from the United States, Mexico, Central America, and the West Indies. Advantage was taken of an opportunity during the spring of 1918, to work in the Arthur Herbarium, Purdue University Agricultural Experiment Station, and the facilities provided by Professor H. S. Jackson, the advice of Dr. J. C. Arthur, and the aid rendered by several assistants, particularly Misses Evelyn Allison and Grace Wineland, and Mr. H. R. Rosen, have been in a large measure responsible for the results attained. Especial thanks are due Mr. Rosen for painstaking microscopic studies which were of the greatest value in defining the limits of the species. Type specimens of the new species are in the Arthur Herbarium.

About a dozen species of rust have been described on *Cyperus*. Five species are recognized in this paper. Four of the several possible names are applicable and one new name is proposed. Some of the established names are included in the synonomy and four are excluded. They either represent species not in our range or sufficient information is lacking to permit a proper disposition. An annotated list of these is included. No 1-celled teliosporic form has been described on *Cyperus*. Fewer species of rust have been described on *Eleocharis*. In North America we have known two, as many more are described here. Much culture work needs to be done. Only two of the nine species have their aecial stages known and two are known in the uredinial stage only.

KEY

HOSTS BELONGING TO GENUS CYPERUS (OR KYLLINGA)

- Urediniospore-pores 2, equatorial.
  - Urediniospore-wall 1–2 µ thick, uniform.
    - 1. *Puccinia canaliculata.*
  - Urediniospore-wall 1.5–2.5 µ thick, frequently thicker above.
    - 2. *Puccinia Cyperi-tagetiformis.*
- Urediniospore-pores usually 3 (in occasional spores 4 or 2), equatorial.
  - Urediniospore-wall 1.5 µ, or less, thick.
    - Urediniospore-wall nearly colorless, teliospore-wall 1.5–3 µ above.
      - 3. *Puccinia antioquiensis.*
    - Urediniospore-wall cinnamon-brown, teliospore-wall 3–5 µ above.
      - 4. *Puccinia abrepta.*
  - Urediniospore-wall 1.5–2 µ thick, teliospore-wall 7–12 µ above.
    - 5. *Puccinia Cyperi.*

HOST BELONGING TO GENUS ELEOCHARIS.
Teliospores 2-celled.
Urediniospore-pores 2, equatorial.
Urediniospores small, 13–21 × 18–27 μ.
6. *Puccinia liberta.*
Urediniospores large, 18–26 × 27–37 μ.
7. *Uredo incomposita.*
Urediniospore-pores usually 4 (in occasional spores 3 or 5), equatorial.
8. *Puccinia Eleocharidis.*
Teliospores 1-celled. 9. *Uromyces Eleocharidis.*

1. PUCCINIA CANALICULATA (Schw.) Lagerh. Trömso Mus. Aarsh. **17**: 51. 1894

Sphaeria canaliculata Schw. Trans. Am. Phil. Soc. II. **4**: 209. 1832.
Aecidium compositarum Xanthii Ellis, N. Am. Fungi *1018b*. 1883.
Aecidium compositarum Ambrosiae Burrill; DeToni, in Sacc. Syll. Fung. **7**: 798. 1888.
Aecidium compositarum Xanthii Burrill; DeToni, in Sacc. Syll. Fung. **7**: 799. 1888.
Puccinia cellulosa B. & C.; Cooke, in Grevillea **20**: 108. 1892.
Uredo ustulata B. & C.; Cooke, in Grevillea **20**: 110, hyponym. 1892.
Puccinia nigrovelata Ellis & Tracy; Ellis & Ev. in Bull. Torrey Club **22**: 60. 1895.
Dicaeoma canaliculatum Kuntze, Rev. Gen. 3^3 466. 1898.
Dicaeoma nigrovelata Kuntze, Rev. Gen. 3^3: 469. 1898.

O. Pycnia amphigenous, gregarious, in small compact groups, honey-yellow becoming brownish, inconspicuous, globoid, 112–128 μ in diameter; ostiolar filaments up to 35 μ or more long.

I. Aecia chiefly hypophyllous, in orbicular or elongated groups 2–5 mm. or more across, on larger discolored spots or on swollen areas on the stems, cupulate, low, 0.2–0.3 mm. in diameter; peridium delicate, the margin finely eroded and slightly recurved; peridial cells rhomboidal, 23–29 μ long, slightly overlapping, the outer wall thick, 5–8 μ, striate, the inner wall thinner, 2–4 μ, verrucose; aeciospores globoid, often angular, 13–16 by 15–19 μ; the wall thin, 1 μ or less, finely verrucose.

ON AMBROSIACEAE:

Ambrosia trifida L., Indiana, Missouri.
Xanthium sp., Arkansas, Delaware, Indiana, Iowa, New Mexico, Pennsylvania.

II. Uredinia chiefly hypophyllous, scattered, oblong, 0.5–2 mm. long, tardily dehiscent by longitudinal slits, ruptured epidermis conspicuous, somewhat pulverulent, cinnamon-brown; urediniospores broadly ellipsoid or obovoid, 13–19 by 19–29 μ; the wall yellowish or cinnamon-brown, 1–2 μ thick, moderately and finely echinulate; the pores 2, equatorial.

III. Telia chiefly hypophyllous, scattered or more often confluent in groups 1–3 mm. or more long, individual sori linear, 0.1 mm. or less in width and surrounded by well developed brownish stroma, blackish or grayish-black, long covered by the epidermis, not or only slightly raised above the leaf surface; teliospores clavate-oblong, 15–21 by 39–64 μ, acuminate, obtuse or rounded above, narrowed below, slightly or not constricted at septum; the wall dark cinnamon-brown, lighter toward base, about 1 μ thick, much thicker above, 3–10 μ; pedicel short, tinted.

ON CYPERACEAE:

Cyperus cylindricus (Ell.) Britton (*C. Torreyi* Britton), Delaware.

Cyperus esculentus L., California, District of Columbia, Florida, Indiana, Kansas, Michigan, Nebraska, New Jersey, New Mexico, Oklahoma, Texas; Mexico (state), Toluca.

Cyperus fendlerianus Boeckl., New Mexico.

Cyperus ferax L. C. Rich, Cuba; Porto Rico.

Cyperus giganteum Vahl, Porto Rico.

Cyperus Hallii Britton, Missouri.

Cyperus Houghtonii Torrey, Nebraska, Wisconsin.

Cyperus Mutisii (H.B.K.) Griseb., Jamaica.

Cyperus reticulatus L., Porto Rico.

Cyperus rotundus L., Florida, Kansas.

Cyperus seslerioides H.B.K., Mexico (state).

Cyperus speciosus Vahl, Kansas.

Cyperus strigosus L., Alabama, Delaware, Illinois, Indiana, Iowa, Kansas, Louisiana, Michigan, Mississippi, Nebraska, New York, Oklahoma, Pennsylvania, Virginia, West Virginia.

Cyperus surinamensis Rottb. (?), Texas; Cuba.

Cyperus thyrsiflorus Jung. (?), Mexico (state).

Cyperus sp., Colorado, North Carolina, Guatemala; Oaxaca.

Type locality: Bethlehem, Pennsylvania, on *Cyperus* sp.

Distribution: New York to Michigan and Nebraska south through Mexico, Central America and the West Indies.

Exsiccati: Barth. Fungi Columb. *2449, 2758, 4260;* Barth. N. Am. Ured. *136, 137, 233, 337, 839, 1038, 1430, 1637;* Carleton, Ured. Am. *10;* Ellis, N. Fungi *1018b;* Ellis & Ev. Fungi Columb. *552, 983, 1760, 2144, 2146;* Ellis & Ev. N. Am. Fungi *3143, 3352;* Seym. & Earle, Econ. Fungi *393*.

A comparison of the types of *Puccinia canaliculata* Schw. and *P. Cyperi* Arth. shows clearly that they are distinct species. The presence of a strongly developed stroma in the telia of *P. canaliculata* and a lack of a similar development in *P. Cyperi* is one of the most conspicuous differences. There are also other distinguishing characters in the telia. In *P. canaliculata* the telia are not much raised above the surface and the epidermis does not rupture noticeably whereas in the other species the telia are pulvinate and the ruptured epidermis becomes conspicuous. Important differences in the urediniospores particularly in size of the spores and arrangement of pores help to make the separation of the two species unquestionable. This is the only *Cyperus* rust which has been cultured. For record of first cultures see Journal of Mycology **12**: 23. 1906.

2. **Puccinia Cyperi-tagetiformis** (P. Henn.) comb. nov.

Uredo Cyperi-tagetiformis P. Henn. Engler's Bot. Jahrb. **34**: 598. 1905.

O and I. Pycnia and aecia unknown.

II. Uredinia hypophyllous and culmicolous, scattered, oblong, 0.5–2 mm. long, tardily dehiscent by longitudinal slits, bullate, finely pulverulent, cinnamon-brown; urediniospores broadly ellipsoid or slightly obovoid, 15–21 by 19–26 μ; the wall dark cinnamon-brown or somewhat lighter, 1.5–2.5 μ thick, frequently thicker and lighter at apex, up to 3 μ, verrucose or verrucose-echinulate, the markings more pronounced above, the pores 2, equatorial.

III. Telia chiefly hypophyllous, most often confluent in groups 1–4 mm. or more long, individual sori linear, about 0.1 mm. in width, surrounded by well developed brownish stroma, blackish-brown, long covered by the epidermis, not much raised above the

leaf surface; teliospores clavate-oblong, 14–18 by 31–48 μ acuminate, obtuse or rounded above, narrowed below, slightly constricted at septum; the wall golden or light cinnamon-brown, about 1 μ thick, much thicker above, 6–10 μ; pedicel short, slightly tinted.

ON CYPERACEAE:

Cyperus distans L., Porto Rico.
Cyperus flavicomus Michx., Texas.
Cyperus laevigatus L., Porto Rico.
Cyperus odoratus L., Cuba; Porto Rico.
Cyperus polystachys Rottb., Porto Rico.
Cyperus radiatus Vahl, Porto Rico.
Cyperus sphacelatus Rottb., Porto Rico.
Cyperus surinamensis Rottb., Porto Rico.

Type locality: Kamodamura, Tosa, Japan, on *Cyperus tagetiformis.*

Distribution: Southeastern Texas and the West Indies.

When described this species was known in the uredinial stage only. Teliospores have been found since which are of the 2-celled type. The urediniospore-pore arrangement is similar to the preceding species but the thicker walls of the urediniospores which are frequently thicker and lighter at the apex are very distinctive characters. Except for a single specimen from Texas the distribution in our range is limited to Porto Rico.

3. PUCCINIA ANTIOQUIENSIS Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 473. 1913

O and I. Pycnia and aecia unknown.

II. Uredinia amphigenous and caulicolous, scattered, small, punctiform or somewhat oblong, long covered by the epidermis; urediniospores broadly ellipsoid or obovoid, 14–19 by 18–26 μ; the wall nearly colorless or pale yellow, thin, about 1 μ minutely and sparsely echinulate; the pores obscure, apparently 3, equatorial.

III. Telia caulicolous or hypophyllous, scattered, rounded or slightly elongated, long covered by the epidermis, finally dehiscent and somewhat pulverulent; teliospores clavate-oblong, 11–16 by 35–50 μ, rounded, truncate or somewhat acuminate at apex, attenuate at base, slightly or not constricted at septum; the wall

golden- or light cinnamon-brown, paler below, very thin, about 1 μ, thicker at apex, 1.5–5 μ, smooth; pedicel about half length of spore, slightly tinted.

ON CYPERACEAE:

Cyperus diffusus Vahl, Panama.

Type locality: Antioquia, Columbia, on *Cyperus diffusus*.

Distribution: Panama; also in South America.

Puccinia antioquiensis as described by Mayor from Columbia is a decidedly characteristic species. The pale thin walls of both urediniospores and teliospores, and the slight thickness at the apex of the teliospores, put the species in a class by itself. Our specimen from Panama is on the same host as the type specimen and agrees perfectly in all respects.

4. **Puccinia abrepta** sp. nov.

O and I. Pycnia and aecia unknown.

II. Uredinia hypophyllous, scattered, oval or oblong, 0.3–1 mm. long, somewhat bullate, rather tardily naked, ruptured epidermis conspicuous, cinnamon-brown; urediniospores ellipsoid or obovoid, 16–19 by 23–26 μ; the wall cinnamon-brown, 1–1.5 μ thick, moderately or sparsely echinulate; the pores 3, equatorial, covered with a swollen hyaline cuticle.

III. Telia not seen; teliospores narrowly ellipsoid or oblong, 13–16 by 27–45 μ, rounded above and slightly narrowed below, somewhat constricted at septum; the wall light cinnamon-brown, thin, 1 μ or less, thicker above, 3–5 μ, smooth; pedicel about one-half length of spore, tinted.

ON CYPERACEAE:

Cyperus ferax L. C. Rich, Costa Rica.

Type collected at San Jose, Costa Rica, Jan. 8, 1916, *E. W. D. Holway 385*.

Distribution: Known only from the type locality.

The specimen here used as the basis of a new species differs from *Puccinia antioquiensis* in the darker, thicker-walled urediniospores and in the thicker apex of the teliospores. It differs from *Puccinia Cyperi* particularly in the smaller size of the urediniospores and in the thinner apex of the teliospores. The host of the

type was determined by P. C. Standley. The specimen was reported by Arthur in the Costa Rican list of Uredinales as *P. canaliculata.*[4]

5. PUCCINIA CYPERI Arth. Bot. Gaz. **16**: 226. 1891

Dicaeoma Cyperi Kuntze, Rev. Gen. 3^3: 466. 1898.

O and I. Pycnia and aecia unknown.

II. Uredinia chiefly hypophyllous, scattered, often very numerous, oblong, 0.3–1.5 mm. long, tardily dehiscent by longitudinal slits, somewhat bullate; urediniospores ellipsoid or obovoid, 18–24 by 24–35 μ; wall light cinnamon-brown, 1.5–2 μ thick, moderately and finely echinulate; the pores equatorial, usually 3, in occasional spores 4 or 2.

III. Telia chiefly hypophyllous, in groups 1.6 mm. long, or scattered, individual sori linear 0.1–0.2 mm. in width, with no or only slight development of stroma, somewhat tardily naked, dark chocolate-brown or blackish, pulvinate, ruptured epidermis conspicuous; teliospores broadly clavate-oblong, 18–26 by 35–61 μ, rounded or truncate above, narrowed below, slightly constricted at septum; wall chestnut-brown, paler below, about 1–1.5 μ thick, much thicker above, 7–12 μ, smooth; pedicel short, tinted.

ON CYPERACEAE:

Cyperus atropurpureus Liebm., Mexico (state).

Cyperus Buckleyi Britton, Michoacan.

Cyperus Buchii Britton, Kansas.

Cyperus cayennensis (Lam.) Britton, Cuba; Porto Rico.

Cyperus cylindricus (Ell.) Britton (*C. Torreyi* Britton), Alabama, Texas.

Cyperus filiculmis Vahl, Connecticut, Delaware, Indiana, Kansas, Massachusetts, Nebraska, New York, Oklahoma, Texas, West Virginia, Wisconsin.

Cyperus flavicomus L., Mexico (state).

Cyperus globosus Aubl. (*C. echinatus* Wood), Alabama.

Cyperus Grayi Torrey, New York.

Cyperus hermaphroditus (Jacq.) Standley, Guatemala.

Cyperus Houghtonii Torrey, Wisconsin.

Cyperus lancastriensis Porter, Delaware.

[4] See Mycologia **10**: 129. 1918.

Cyperus mutisii (H.B.K.) Griseb., Jamaica.

Cyperus ovularis (Michx.) Torrey, Alabama, Delaware, South Carolina.

Cyperus refractus Engelm., Delaware.

Cyperus retrofractus (L.) Torrey, Alabama.

Cyperus Schweinitzii Torrey, Illinois, Iowa, Indiana, Nebraska, Oklahoma, Wisconsin.

Cyperus spectabilis Scheb., Mexico (state), Morelos.

Cyperus strigosus L., Indiana, Missouri, New York.

Cyperus sp., North Carolina.

Kyllinga brevifolia Rottb., Porto Rico.

Kyllinga pumila Michx., Grenada; Porto Rico; Martinique; Vera Cruz.

Kyllinga odorata Vahl, Guatemala.

Type locality: Decorah, Iowa, on *Cyperus Schweinitzii*.

Distribution: Massachusetts, Wisconsin and Nebraska south through Mexico, Central America and the West Indies.

Exsiccati: Barth. N. Am. Ured. *542, 837, 838, 1436;* Ellis & Ev. Fungi Columb. *1850, 2145;* Ravenel, Fungi Am. *278, 498;* Sydow, Ured. *1016, 1017, 1177.*

Puccinia Cyperi has long been confused with *P. canaliculata* as explained in the note under that species. It is most certainly entitled to recognition. The list of hosts includes three species of *Kyllinga*, a comparatively small genus rather closely related to *Cyperus*.

6. **Puccinia liberta** sp. nov.

O and I. Pycnia and aecia unknown.

II. Uredinia chiefly culmicolous, scattered, usually numerous, oval or oblong, 0.3–1.5 mm. long, sometimes longer by becoming confluent, tardily dehiscent by longitudinal slits, somewhat bullate, slightly pulverulent after dehiscence; urediniospores broadly ellipsoid or obovoid, sometimes more or less laterally compressed, 13–21 by 18–27 μ; the wall golden- or cinnamon-brown, 1.5–2 μ thick, moderately and finely echinulate; the pores 2, equatorial.

III. Telia rare, only few seen, resembling uredinia in shape and size, darker in color, tardily dehiscent by longitudinal slits, compact; teliospores clavate-oblong or fusiform, 14–18 by 40–50 μ, rounded or acuminate above, usually narrowed below; the wall golden- or cinnamon-brown, often paler at apex, 1–1.5 μ thick, thicker above, 4–7 μ, smooth; pedicel short, tinted.

ON CYPERACEAE:

Eleocharis cellulosa Torrey, Porto Rico.
Eleocharis flaccida (Spr.) Urb., Porto Rico.
Eleocharis geniculatus (L.) R. Br., Cuba; Guatemala; Porto Rico.
Eleocharis montana (H.B.K.) R. & S., California.
Eleocharis mutata (L.) R. & S., Porto Rico.
Eleocharis sp., Nicaragua.

Type collected at Grenada, dept. Grenada, Nicaragua, on *Eleocharis* sp., Feb. 11, 1903, *C. F. Baker 2385*.

Distribution: The West Indies and Central America and in southern California.

The species here described differs from *Puccinia Eleocharidis* very markedly in urediniospore characters. The urediniospores are smaller, somewhat thicker-walled and possess 2 equatorial pores as compared with 3–5, usually 4, equatorial pores in *P. Eleocharidis*. The distribution is tropical or sub-tropical whereas *P. Eleocharidis* is chiefly a temperate region species. Judging from the size of the urediniospores and the arrangement of the pores *Puccinia liberta* appears to be the correlated form of *Uromyces Eleocharidis*. The type specimen is a part of a collection distributed by Baker as "Plants of Central America," and although somewhat fragmentary bears both uredinal and telial stages. There is a more ample specimen of the type collection at the N. Y. Botanical Garden.

7. **Uredo incomposita** sp. nov.

O and I. Pycnia and aecia unknown.

II. Uredinia chiefly culmicolous, scattered or sometimes in more or less evident groups, oval or oblong, 0.4–1.5 mm. or more long, tardily dehiscent by longitudinal slits, somewhat bullate; urediniospores broadly ellipsoid or obovoid, often somewhat angular, 18–26 by 27–37 μ; the wall golden- or cinnamon-brown, moderately echinulate, 1.5–2 μ thick; the pores 2, equatorial.

III. Telia not known.

ON CYPERACEAE:

Eleocharis geniculatus (L.) R. Br., Porto Rico.
Eleocharis interstincta (Vahl) R. & S., Porto Rico.
Eleocharis sp., Guatemala.

Type collected at Mayaguez, Porto Rico, on *Eleocharis interstincta,* May 20, 1916, *Whetzel & Olive 35.*

Distribution: Known only from Porto Rico and Guatemala.

No teliospores could be found on the specimens here cited as the foundation of a new species but the urediniospore structure is so characteristic that no other disposition seems satisfactory. The pore arrangement is like that of the preceding species but the spores are very much larger and although often somewhat angular are not laterally compressed. The host of the type specimen was determined by Dr. Britton. The collection was cited as *Puccinia Eleocharidis* by Arthur in the "Uredinales of Porto Rico based on collections by H. H. Whetzel and E. W. Olive."[5]

8. PUCCINIA ELEOCHARIDIS Arth. Bull. Iowa Agr. Coll. Dept. Bot. **1884**: 156. 1884

Aecidium compositarum Eupatorii DeToni: in Sacc. Syll. Fung. **7**: 798. 1888.

Dicaeoma Eleocharidis Kuntze, Rev. Gen. **3**^{2}: 468. 1898.

O. Pycnia amphigenous, few in small orbicular groups, punctiform, honey-yellow becoming reddish-brown, rather inconspicuous, globoid, 100–170 μ in diameter; ostiolar filaments 35–60 μ long.

I. Aecia hypophyllous, in crowded groups or in orbicular groups about the pycnia on discolored spots that are usually conspicuous, cupulate, low, 0.2–0.3 mm. in diameter; peridium delicate, the margin deeply lacerate and revolute; peridial cells rhomboidal, 24–34 μ long, the outer wall 4–6 μ thick, striate, the inner wall 2–3 μ, verrucose; aeciospores globoid, 16–21 by 18–24 μ; the wall colorless, about 1 μ thick, finely verrucose.

ON CARDUACEAE:

Eupatorium maculatum L., Indiana, Iowa, Nebraska, New York.

Eupatorium perfoliatum L., Delaware, Illinois, Iowa, Indiana, Kansas, Maine, Michigan, Nebraska, New York, Pennsylvania, Wisconsin; Nova Scotia, Ontario.

Eupatorium purpureum L., Alabama, Indiana, Iowa, Michi-

[5] See Mycologia **9**: 76. 1917.

gan, Nebraska, New Jersey, New York, Pennsylvania, Wisconsin, Manitoba, Quebec.

Eupatorium rotundifolium L., Delaware, Mississippi.

Eupatorium serotinum Michx., Louisiana.

Eupatorium verbenaefolium Michx., Alabama.

II. Uredinia chiefly culmicolous, scattered, oblong, 0.3–1 mm. long, tardily dehiscent by longitudinal slits, somewhat bullate; uredinospores broadly ellipsoid or obovoid, 17–24 by 26–40 μ; the wall yellowish or light cinnamon-brown, about 1.5 μ thick, rather sparsely and finely echinulate; the pores equatorial, usually 4, in occasional spores 3 or 5.

III. Telia chiefly culmicolous, scattered, oblong, 0.5–1.5 mm. long, tardily dehiscent by longitudinal slits, somewhat bullate, blackish-brown; teliospores clavate-oblong, 13–19 by 32–65 μ, slightly or not constricted at septum, truncate, rounded, or obtuse above, somewhat narrowed at the base; the wall light chestnut-brown, paler below, smooth; about 1 μ thick, much thicker at apex, 3–7 μ; pedicel short, tinted.

ON CYPERACEAE:

Eleocharis capitata (L.) R. Br. (*Scirpus capitatus* L.), Cuba; Porto Rico.

Eleocharis intermedia (Muhl.) Schult., Iowa, New York, Pennsylvania.

Eleocharis obtusa (Willd.) Schult., Indiana, Oklahoma.

Eleocharis ovata (Roth) R. & S., New York, West Virginia.

Eleocharis palustris (L.) R. & S. (*E. glaucescens* Willd., *E. palustris glaucescens* A. Gray), Indiana, Iowa, Kansas, Michigan, Nebraska, Wisconsin; Ontario, Quebec.

Eleocharis tenuis (Willd.) Schult., Maine, Nebraska, New York.

Eleocharis sp., Texas, Virginia; Manitoba.

Type locality: Spirit Lake, Iowa, on *Eleocharis intermedia.*

Distribution: Maine and Quebec to Manitoba, south to the Gulf of Mexico, and in Cuba and Porto Rico, with aecia known only from the eastern United States and adjacent parts of Canada.

Exsiccati: Barth, Fungi Columb. *2355, 2759, 4144, 4662;* Barth, N. Am. Ured. *338, 840, 938, 1043, 1238;* Ellis, N. Am. Fungi *1419;* Ellis & Ev., Fungi Columb. *1458, 1802, 2147;* Griff., W.

Am. Fungi *330;* Shear, N. Y. Fungi *127;* Sydow, Ured. *2023, 2414, 2516.*

Puccinia Eleocharidis is the common 2-celled form on *Eleocharis.* It is the only species on this host which has been cultured. For record of first cultures see Journal of Mycology **12** : 23. 1906. It is interesting that the aecial distribution appears to be limited to a portion of the area covered by the uredinial and telial stages. This situation is of course entirely possible but on the other hand further collecting may alter the situation. The aecia on *Eupatorium* are often not conspicuous and may have been overlooked in the southern range of the species.

9. UROMYCES ELEOCHARIDIS Arthur, Bull. Torrey Club **33**: 514. 1906

Nigredo Eleocharidis Arth. N. Am. Flora **7**: 232. 1912.

O and I. Pycnia and aecia unknown.

II. Uredinia amphigenous, scattered, oblong, 0.3–1.5 mm. long, tardily dehiscent by one or more longitudinal slits, dark cinnamon-brown; urediniospores ellipsoid to broadly ellipsoid, 15–19 by 19–29 μ; wall golden-yellow, thin, 1–1.5 μ, sparsely and finely echinulate, the pores 2, approximately equatorial.

III. Telia amphigenous, thickly scattered, oblong, 0.5–2 mm. or more long, tardily dehiscent by longitudinal slits, chocolate-brown; teliospores angularly obovoid, truncate or rounded above, narrowed below, 16–22 by 27–45 μ; wall light chestnut-brown, rather thin, 1–1.5 μ, thicker above, 7–10 μ, smooth; pedicel tinted, about once to once and a half length of spore.

ON CYPERACEAE:

Type locality: Aberdeen, South Dakota, on *Eleocharis palustris.*

Distribution: Northern Mississippi and Missouri basins.

Exsiccati: D. Griff., W. Am. Fungi *60, 60a;* Barth, Fungi Columb. *2293, 3291;* Sydow, Ured. *2102, 2252;* Brenckle, Fungi Dak. *50.*

EXCLUDED NAMES

Puccinia Romagnoliana Maire & Sacc. Ann. Myc. **1**: 220. 1903.

According to the Sydow Monograph this species is near *Puccinia Cyperi.* It is even suggested that it may be only the Euro-

pean form of our species. The teliospores differ materially, particularly in thickness of walls. The walls are 2–2.5 μ thick whereas all of our species on *Cyperus* have notably thin walls, none of them having walls more than 1.5 μ thick and for the most part they are 1 μ or less. The urediniospores have pores often above the equator, an arrangement not found in any of our species.

Puccinia conclusa Thüm. in Contr. Flor. Lusit. in Jour. d. sc. math. phys. e nat. Lisboa **24**: 10. 1878. From Coimbra, Portugal.

No specimen has been available; uredinia are not described.

Puccinia subcoronata P. Henn. Hedw. **34**: 94. 1895. From Goyaz, Brazil.

Apparently differs from our species in coronate condition of teliospores. Our specimen bearing this label does not appear to be authentic.

Uredo philippinensis Sydow, Ann. Myc. **4**: 32. 1906.

Has much smaller urediniospores than any of our species.

Uredo eleocharidicola Speg. Anal. Mus. Nac. Buenos Aires **6**: 237. 1899.

Resembles *Puccinia liberta* but is not identical.

DEPARTMENT OF BOTANY,
THE PENNSYLVANIA STATE COLLEGE.

NEW JAPANESE FUNGI

NOTES AND TRANSLATIONS—VII

TYÔZABURÔ TANAKA

DIDYMELLA MORI K. Hara sp. nov. in Dainippon Sanshi Kwaiho (Journn. Sericultural Association of Japan), **26**^{304}: 388, 1 text cut. May, 1917. (Japanese.)

Spots inconspicuous; perithecia scattered, punctiform, black, covered by the epidermis which is raised and finally pierced, globoid or depressed globoid, 200–250 µ high, 250–300 µ in diam.; perithecial wall thick, fungoid-parenchymatous, black, cells not definitely distinguished; asci cylindric or long clavate, rounded above, attenuate to short sterigmata below, 70–80 × 5–8 µ, octosporous, paraphysate; ascospores obliquely monostichous, fusoid, ellipsoid or sub-ovoid, slightly narrowed at both ends, uniseptate at the middle, more or less constricted, 2–3-nucleate in the young stage, homogenous at maturity, colorless, 12–15 × 5–6 µ; paraphyses filiform, longer than asci, 1 µ across.

Illustrations: One text cut with four figures showing spots, perithecium, asci, and ascospores.

On twigs of *Morus alba.*

Type locality: Mino (Gifu-ken Prefecture) Kawakami-mura, Oct., 1915, K. Hara.

MYCOSPHAERELLA COLACASIAE K. Hara sp. nov. in Byôchû-gai Zasshi (Journ. Plant Protection), Tôkyô. **5**^{5}: 355–356. May, 1917. (Japanese.)

Perithecia scattered, punctiform, immersed, later erumpent, globoid or depressed globoid, 60–120 µ diam., black; perithecial wall fungoid-parenchymatous, dark-brown, cells 5–13 µ across; ostiola terminal, verrucaeform or papilliform, often not prominent, simply perforated, openings comparatively large, 25–30 µ across; asci cylindric or clavate, inconspicuously pointed above or more generally rounded, attenuate below, pedicellate, 45–70 × 8.5–10 µ, octosporous; ascospores biseriate, fusoid, more or less excentrically uniseptate, constricted, upper cell broader and

shorter, pointed, lower cell sometimes attenuate, mostly rounded, 2-nucleate in each cell, 13–17 × 4–5 μ, hyaline, colorless.

On leaves of *Colocasia antiquorum*.

Type locality: Not given. Probably Main Island (Honshû), Japan.

Spots solitary or confluent, at first round, testaceous brown, 1.5 mm. across, finally increasing to 6–30 mm., concentrically zoned and more or less sunken from the surface level, with dark brown margin and broad surrounding area of the same color; perithecia appear on the upper surface of the spots. When the diseased spots reach full maturity they can be seen from the lower surface of the leaf and appear light brownish with dark green margin.

The disease is frequently observed when the host plants are cultivated in damp soil and the first symptoms show during the hottest season. The disease greatly decreases the crop as the tubers cannot grow to the usual size.

For protection against this disease Bordeaux mixture should be used twice or three times in early summer, and if the diseased leaves can be found they should be carefully collected and buried underground with lime. Also avoid cultivation on low, damp soil.

VALSA MALI Miyabe et Yamada ex M. Miura in Nôji Shiken Seiseki (Agricultural Experiment Station Bulletin) Aomori-ken, Japan, No. 15: 117–141. *pls. 1–5,* T. 4, ix, Nov., 1915. (Japanese.)

Hyphae septate, hyaline or very pale olivaceous, intercellular, 2–4 μ across; stromata cortical, punctiform or wart-like, of various sizes (1–3 mm. diam. in cultures), no definite border to the host substratum, black, hyphae slate-black to black; pycnidia deeply immersed at the center of a stroma, flask-shaped, opening with a slender canal-like neck, 80–200 μ diam., circumscribed by black walls; pycnospores expelled as thread-like buff tendrils which at maturity are readily disseminated by water; cylindrical or allantoid, obtuse at both ends, 7–10 × 1–1.5 μ, homogeneous inside, hyaline; perithecia circinate surrounding the pycnidial cavity, flask-shaped, long-necked, with black walls, of various sizes, 100–250 μ diam.; asci numerous, clavate, often pedicellate, 20–30 × 5–8 μ, hyaline, octosporus, aparaphysate; ascospores cylindrical, slightly curved, continuous, nearly as large as pycnidia, hyaline, agranulate.

On apple, causing a somewhat destructive blight disease, called "Furanbyô" in Japanese. The disease first appears on the surface of branches as brownish spots with irregular or nearly oblong circumference, slightly elevated from healthy portion, then gradually drying out, inconsiderably sunken, more or less darkened, and cracking on the outer surface, finally disclosing the pustules which are scattered over the diseased surface. No secretion of liquid was observed, which is usual in case of fire-blight (Hiyakebyô) caused by *Bacillus amylovorus* also known in northern Japan.

Type locality: Not given. Distribution: Northern part of Honshû and Hokkaidô.

The name, *Valsa Mali,* first appeared in a list of important fruit diseases of North Island compiled by Sapporo Agricultural College, which was exhibited at the Fifth Industrial Exposition held at Osaka during 1903–04 ("Sapporo Nôgakkô Hen, Hokkaidô Jûyô Kwaju Byôgai" n. d., printed before April 1, 1903), later described by Y. Takahashi and H. Okamoto in Hokkaidô Nôji Shikenjo Ihô (Circular of the Hokkaidô Agr. Exp. Sta.) No. 5: 39–41, fig. 18, published March, 1908. A more detailed account of the fungus was given by Dr. A. Ideta in his Nippon Shokubutsu Byôrigaku (Handbook of the Plant Diseases in Japan) ed. 4, pt. 1 (1909), pp. 295–297, where the original drawing of Prof. G. Yamada is first printed and the dimensions of ascopores are given as $8 \times 1.5\,\mu$. Cultural tests were recently reported by Dr. T. Hemmi in Trans. Sapporo Nat. Hist. Soc., **6**[2]: 146–152 (July, 1916), and in Journ. Tôhoku Imp. Univ., Coll. of Agric., **7**[1]: 277–287 (Aug., 1916), where the activity of the growth is stated to be remarkably accelerated by an addition of 0.1–0.2 per cent. pyrotannic acid or 0.8 per cent. citric acid to the culture medium.

DIAPORTHE MALI Miura sp. nov. in Nôji Shiken Seiseki (Agr. Exp. Sta., Bull.) Aomori-ken, Japan. No. 15: 77–116, *pls. 2, 3, 5.* T. 4, ix, Nov., 1915. (Japanese.)

Pomiicolous, caulicolous, often foliicolous; mature spots on fruits 2–8 mm. diam., size not increasing further under natural conditions, round, solitary or irregularly coalescent, more or less

sunken, usually deeper in color than the healthy part, changing the underlying tissue to brown or dark-brown, tissue becoming spongy, imparting slightly bitter taste; hyphae intercellular, septate, 2–5 μ diam., readily producing chlamydospores and cylindrospores in culture; chlamydospores (formed in culture) catenulate, cinereous or greenish, thick-walled, conspicuously constricted at the junction, numerously granulate, 10–14 × 5–8 μ; cylindrospores (formed in culture from fruit spot) straight or curved, tapering toward the apex, pale pinkish-brown in mass, colorless or indistinctly greenish when observed alone, 2–7-septate, occasionally constricted at septum, 38–70 × 3–3.5 μ, those obtained from leaves in culture measuring 32–80 × 3–4 μ; pycnidia, formed as brownish black spots on the surface of entirely decayed fruit, numerous, irregular or often growing in concentric zones, afterwards covered by white or pale olivaceous-white cottony hyphae, semi-spherical, 70–220 × 70–130 μ, at full maturity exuding from the central opening, a pinkish-brown semi-liquid substance composed of two kinds of pycnospores, characteristic of the genus *Phomopsis;* conidiospores 15–18 × 2–3 μ; Phoma-spore ellipsoidal, pointed rather distinctly at both ends, contiunous, hyaline, guttulate at both ends, 7–9 × 3–4 μ; Septoria-spore filiform, slightly curved either near the apex or at the middle, continuous, hyaline, 24–32 × 1–3 μ; stromata formed in culture and on decayed twigs placed on culture media, irregular, black outside, white inside, 3–7 mm. diam., producing flat, central Phomosis pycnidia of about 1–1.5 mm. diam., and a certain number of surrounding Diaporthe perithecia with protruding ostiola visible to the naked eye; perithecia (observed on twigs above mentioned) spheroidal or oblate-spheroidal, 300–450 μ diam., with intensely black outer wall and light-brown inner wall; ostiola rather long, conspicuously hairy near the end, with projecting hyphae; asci fusoid, obtuse above, inconspicuously pedicellate below, 45–52 × 5–10 μ, octosporous, aparaphysate; ascospores biseriate, fusoid, both ends obtuse, one-septate, constricted, 2-nucleate in each cell, hyaline, 11–13 × 3.5–4.5 μ.

Leaf-spots occur as pale discolored areas of 1–2 cm. diam., usually producing leaf-curl and final defoliation during the summer, showing under microscope mycelial development through the tissue. Young shoots as well as bearing twigs also show irregular brownish infection at the point about six inches from the end, gradually drying and cracking the surface, finally causing death of the tip of the shoot.

On fruit, leaf and twig of apple.

Locality: Northern Japan (very common).

Illustration: Two collotype plates showing infections of twigs and fruits of apple, one lithographic plate giving detailed structure of the fungus in various stages.

Note: The fruit spot of apple (*Heikwa no Hantenbyô* in Japanese) here described is very widely distributed throughout the territory, most frequently occurring on Jonathan apple, the spotted fruit of which is almost considered as characteristic of the variety. Though closely resembling *Phoma Pomi* Pass. in the cylindrospore formation, the *Phomopsis* stage is entirely different from that, indicating a common identity with *Phomopsis Mali* Rob. which is reported as occurring only on twigs and not on fruits. The discovery of the ascogenous form in culture enabled the investigator to prove these observed forms stages of *Diaporthe*. "Diaporteose" is proposed as the new English name for this disease.

PHRAGMIDIUM RUBI-SIEBOLDII Kawagoe sp. nov. in Kagoshima Kôtô Nôrin Gakkô Gakujutsu Hôkoku (Bull., Kagoshima Imp. Coll. Agr. and Forest.), Kagoshima, no. 1; 201–203, 1 pl. T. 5, iii, Mar., 1916. (Japanese.)

III. Telia hypophyllous, elongated, orange yellow, quite conspicuous macroscopically as silky protrusions of veins through laciniately ruptured epidermis, discoloration of the upper surface being brownish, the margin of which is rather indefinite; hyphae bundles projecting from cortical as well as bast portion of substrata attain to 2,200 μ in whole length when measured with teliospore bundles; teliospores elongate-lanceolate with conspicuously long pedicels, mostly 5-celled, gradually narrowed and sharply pointed at the apex, 136–221 $\times$ 15.6 μ, the terminal cell occupying nearly one half of total length, slightly constricted at the septum, membrane smooth, equally thick, hyaline, 2 μ across, contents granular, mixed with oil globules, orange yellow; pedicels very long, average 2,000 μ in length, membrane thicker than that of spore, measuring 3 μ across, smooth and hyaline, contents also hyaline.

On leaves of *Rubus Sieboldii*.

Type locality: Toso, Nakagôriu-mura, Kagoshima-gun, Kagoshima-ken. (K. Toyohira, May, 1911.)

Illustration: One lithographic plate with a photograph of affected leaf. Teliospores and a magnified cross section of telia are given.

The fungus, discovered only in the place above mentioned, is of doubtful importance so long as the connections with other forms remain obsolete. The fungus occurs on the plant about the beginning of May and lasts until the end of June.

POLYPORUS PUBERTATIS Yasuda sp. nov. in Shokubutsugaku Zasshi (Botan. Magaz.) Tôkyô, **30**[351]: 66. Mar., 1916 (Japanese); l. c. **31**[362]: 54. Feb., 1917 (nom. nud.).

Pilei firmly suberose, sessile, dimidiate, margin semi-circular, cross-section triangular, thick, 7.5–8 × 3–4 × 2–3 cm., light; surface even, minutely velvety with soft fuzzy hairs, azonate, subfuscous; context sub-fuscous, thick; tubes long, about 0.5–1 cm., thick-walled, pinkish; mouths small, rotund; spores numerous, ellipsoid, smooth, 5 × 3 μ.

On wood bark.

Type locality: Miyagi-mura Kashiwagura, Seta-gun, Kôdzuke-nokuni (Gunma-ken prefecture), collected by Jûgorô Tsunoda.

Japanese name: Hônen-take.

Notes: In the latter article this fungus is placed under Sect. 4. *Fusci,* c. "Hymenium ohne Zystiden; Sporen gefärbt."

NEOTTIOSPORA THEAE Sawada sp. nov. in Nôji Shikenjô Tokubetsu Hôkoku (Special report, Agr. Exp. Station) Taiwan (Formosa), No. 11: 113, *pl. 4, figs. 30–31.* T. 4, ii, Feb., 1915. (Japanese.)

Spots epiphyllous, irregular, cinereous to brown, sparingly dotted with black, minute fruiting bodies, margin definite, elevated, purplish-black; pycnidia subepidermal, black, depressed globose to spheroid, 84–93 × 108–135 μ, erumpent with ostiola; pycnospores cylindrical, both ends rounded or obtuse, 12–14 × 3 μ, unicellular, hyaline, ciliate at one end; setae filamentous, 9–11 μ long.

On leaves of *Thea sinensis.* Occurring rarely on mature leaves in Formosa and seems to cause no serious damage.

Type locality: Shinchikuchô Nanshô, May 3, 1910. Y. Fujikuro.

Illustrations: Two black and white lithographic figures.

PESTALOZZIA GOSSYPII Hori sp. nov. ex S. Thuruda, in Byôchû-gai Zasshi (Journ. Plant Protection) 4^3: 27–28. T. 6, iii, Mar., 1917. (Japanese.)

Spot ochraceous-brown, about 16 mm. diam. with irregularly zoned fuligineous margin; acervuli punctate at the middle part of the spot, first covered by epidermis, then erumpent, black, 212–255 μ broad; conidiophores hyaline, $2–4 \times 0.6–0.9\,\mu$; conidia clavate, thickened at the apex, gradually narrowed toward the base, 5-celled, terminal and basal cells hyaline, 3 inner cells fulvous, the middle cell most strongly darkened ($18–27 \times 4–8\,\mu$); setae 2–3, slightly swollen at the apex, hyaline, $6–16 \times 1.6\,\mu$.

On leaves of *Gossypium herbaceum.*

Type locality: Shidzuoka-ken (prefecture) Ogasa-gun Hiki-mura, Dec. 10, 1916, S. Tsuruda.

Japanese name of the disease: Sômen no Hanmonbyô (Leaf-blotch of cotton).

The disease caused a little damage on the upland cotton in the Shidzuoka prefecture during the wet harvest season of 1916 but has never been reported from any other cotton-growing sections of Japan or Chôsen (Korea). It is very easily distinguished from ordinary "Hantenbyô" (Leaf-spot disease, caused by *Cercospora gossypina* Cke.) by its reddish-buffy-brown spots which, in the latter species, present a grayish-brown portion less conspicuously dotted in the center with acervuli.

The dimensions of the conidia, which are omitted in the original publication, were obtained by communication with the original author, Mr. Tsuruda, who, to our greatest regret, died a few days before the reply containing this information reached the writer of this review.

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

NOTES AND BRIEF ARTICLES

Professor John A. Stevenson has recently been called from his work in Porto Rico and is now a pathological inspector for the Federal Horticultural Board in Washington.

Dr. M. W. Gardner resigned the position of assistant pathologist in the Bureau of Plant Industry to take up the investigation of vegetable diseases at the Purdue University Experiment Station, Lafayette, Indiana, beginning February 1.

Mr. Edw. C. Johnson, dean of the Division of Extension of the Kansas State Agricultural College, has resigned to accept the position of dean of the College of Agriculture and director of the Experiment Station, Washington State College, Pullman, Washington.

Mr. J. A. McClintock has resigned his position as extension specialist in cotton, truck, and forage crop diseases in Georgia, to which he was appointed under a cooperative agreement between the United States Department of Agriculture and the Georgia State Experiment Station, with headquarters at Experiment, Georgia.

An important paper by Otto Reinking on Philippine Plant Diseases appeared in the March number of *Phytopathology*.

Mr. O. F. Gleason has recently sent in specimens of *Pleurotus ostreatus* collected early in March of this year. He states that he found no mushrooms growing in February.

A paper on the sporadic appearance of non-edible mushrooms in cultures of ordinary cultivated species was contributed by

Michael Levine to the February number of the *Torrey Bulletin*. *Panaeolus venenosus, P. campanulatus, P. retirugis, Clitocybe dealbata, Melanoleuca melanoleuca,* and *Peziza domiciliana* were discussed at some length and figured on three plates.

In the *Journal of Agricultural Research* for September 2, 1918, Hedgcock, Bethel and Hunt describe a new rust, *Cronartium occidentale.* The rust attacks the piñon pine, its alternate stage occurring on species of *Ribes* and *Grossularia.* While similar to the white pine blister rust which has caused so much damage in the East, it differs in several particulars. The rust does not seem to affect old trees to any great extent but is rather destructive to young ones.

Brown canker of roses caused by a new species of fungus, *Diaporthe umbrina,* is described by Anna E. Jenkins in the number of the *Journal of Agricultural Research* for December 16, 1918. The disease can be produced by inoculation with either the pycnospores or with the ascospores of the host. Sanitation and spraying are recommended as control measures. The disease has been noted in the District of Columbia, Virginia, West Virginia, Georgia and Connecticut.

In the January number of *Phytopathology* M. Shapovalov discusses Some Potential Parasites of the Potato Tuber. Three species, *Penicillium oxalicum, Aspergillus niger* and *Clonostachys rosea,* are found under favorable conditions to cause considerable damage to these tubers. From the discussion it is concluded that there are many dormant enemies of garden crops which deserve much more attention than they have been given in the past.

Harter, Weimer and Adams publish the results of their investigations on Sweet Potato Storage Rots in the *Journal of Agricultural Research* for November 11, 1918. Seventeen different species of fungi were found to be responsible. Of these the chief offenders were: *Rhizopus nigricans, Sphaeronema fimbriatum, Diplodia*

tubericola, Diaporthe batatis, Plenodomus destruens, Sclerotium bataticola and *Monilochaetes infuscans.* Other fungi which cause losses under favorable conditions are *Mucor racemosus, Botrytis cinerea, Gibberella saubinetii, Fusarium culmorum, Fusarium acuminatum, Trichoderma Koningi* and species of *Alternaria, Epicoccum* and *Penicillium.*

The Laboratory of Plant Pathology formerly located at the Royal Botanical Gardens in Kew, England, has recently been transferred to the Rothamsted Experiment Station at Harpenden, where a large new Institute of Research in Phytopathology is being created. Professor W. B. Brierly, the director of the department of plant pathology, will greatly appreciate the coöperation of American plant pathologists in his efforts to assemble a pathological library in the institution.

Mr. Ivan M. Johnston has recently sent to the Garden herbarium a large and valuable collection of woody and fleshy fungi, collected in the mountains about Claremont, California. The collection is accompanied by valuable field notes and sketches. Several species that have been known very imperfectly are represented by a number of good specimens in this collection. Of the 104 numbers sent by Mr. Johnston, the following might be noted:

Ceriomyces flaviporus, Rostkovites granulatus, Prunulus purus, Pyropolyporus Abramsianus, Spongiporus leucospongia, Inonotus dryophilus, Fomes Arctostaphyli, Panellus stypticus, Ganoderma polychromum, and *Funalia stuppea.*

INDEX TO AMERICAN MYCOLOGICAL LITERATURE

Arthur, J. C. Uredinales of Guatemala based on collections by E. W. D. Holway—IV. *Puccinia* on Carduaceae, form-genera and index. Am. Jour. Bot. **5**: 522–550. D 1918.

Includes new species in *Puccinia* (9), *Uredo* (4) and *Aecidium* (1).

Barrus, M. F. Varietal susceptibility of beans to strains of *Colletotrichum lindemuthianum* (Sacc. & Magn.) B. & C. Phytopathology **8**: 589–614. *pl. 1–5.* D 1918.

Buchanan, R. E. Studies in the classification and nomenclature of the bacteria—VIII. The subgroups and genera of the Actinomycetales. Jour. Bact. **3**: 403–406. Jl 1918.—IX. The subgroups and genera of the Thiobacteriales. Jour. Bact. **3**: 461–474. S 1918.

Burnham, S. H. Charles Horton Peck. Mycologia **11**: 33–39. *f. 1.* 21 D 1918.

Burt, E. A. The Thelephoraceae of North America—X. *Hymenochaete.* Ann. Missouri Bot. Gard. **5**: 301–370. *pl. 16, 17 + f. 1–32.* N 1918.

Carsner. E. Angular-leaf-spot of cucumber: dissemination, overwintering and control. Jour. Agr. Research **15**: 201–220. *pl. 13–16 + f. 1–3.* 21 O 1918.

Chapman, G. H. Mosaic disease of tobacco. Massachusetts Agr. Exp. Sta. Bull. 175: 73–117. *pl. 1–5.* My 1917.

Colón, E. D. La enfermedad de las rayas. Hechos establecidos y deducciones practicas. Puerto Rico Dep. Agr. Circ. 14: 1–8. 1918. [Illust.]

Dosdall, L. Overwintering of the aecio spores of *Cronartium ribicola* Fisher. Phytopathology **8**: 619. D 1918.

Durand, E. J. *Peziza proteana* var. *sparassoides* in America. Mycologia **11**: 1–3. *pl. 1.* 21 D 1918.

Elliott, J. A. Storage rots of sweet potatoes. Arkansas Agr. Exp. Sta. Bul. 144: 1–15. *pl. 1–4.* My 1918.

Elliott, J. A. Wood-rots of peach trees caused by *Coriolus prolificans* and *C. versicolor.* Phytopathology **8**: 615–617. *f. 1, 2.* D 1918.

Fox, A. Nut-fall and leaf-droop of cocoanut polus in Cuba. Cuba Rev. **17**: 12–15. D 1918. [Illust.]

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